

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

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THE TREATMENT OF FRACTURES BY METHODS OF SUSPENSION AND EXTENSION

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(From Hôpital 32 bis, Chateau de Passy, Hôpital Français de New York)

COMPARED with its tragic consequences, there can be few advantages resulting from the great war. It is to be hoped, and is indeed quite certain, that the enormous surgical material provided by the wounded will yield some new methods of permanent value to civil surgery. Few problems have faced military surgeons more important than the question of infection and fractures, particularly when they are associated in combined problem like that of compound fractures. They form not only a very considerable percentage of the injuries in modern warfare, but also perhaps the greatest and most difficult single problem of the base hospital. There is nothing particularly new in the treatment of such fractures by suspension and extension, as these methods have been used for years, but the enormous material presented by the war has stimulated the interest of certain hospitals in them, resulting in a widened application of this kind of treatment which should lead to their more extensive use in civil hospitals.

To this particular field, the staff of the American Ambulance has made a conspicuous contribution and has devised many ingenious splints and appliances. To attempt much work of this character, it is first of all desirable to have a good mechanic who can make the necessary splints and adjust the apparatus according to the wishes of the surgeon and then to have a convenient framework upon which the fractured extremities can be suspended and extended. In the previous work with this method in New Haven, we have used a single frame extending from the head to the foot of the bed and giving points of support about 5 feet about its surface. In one ward we have had a removable overhead support like a joist with adjustable pulleys extending over the bed at a height of about 8 feet. This has been employed particularly for Hodgen's splints.

At the American Ambulance, suspension and extension has been applied by means of wooden frames attached to the head and foot of ordinary beds with movable supports running longitudinally to carry the pulleys.

In attempting to develop this feature of our work during my term of service at Hôpital 32 bis, Chateau de Passy, I happened, in visiting an old hospital in the adjacent town of Villeneuve, to see some of the old-fashioned four-posted *lits à baldequin*, such as were used in the Middle Ages in many French hospitals, when patients were surrounded by curtains to protect them from drafts or currents of air. In old prints of the Paris hospitals, in the periods after the Louis, such beds are not infrequently seen. Realizing their possible value for the treatment of fractures, we succeeded, through the courtesy of the Mayor of Villeneuve and the authorities of the Hotel Dieu, in exchanging for the period of war a series of our American for these old-fashioned four-posted French beds. It is interesting to know that these identical beds, M. Mayaut, the Mayor, informs me, were purchased by the Hotel Dieu of Villeneuve, more than 150 years ago. They are still in a perfect state of repair and represent to my mind the most ideal form of fracture bed which it is possible to devise. At first we were somewhat concerned lest the springs should prove to be uncomfortable, as they are formed of interlacing bands of spring steel which slope in a gently rounded curve upwards from the foot towards the head of the bed. Experience has shown, however, that not only are they comfortable, but this particular type of spring is perfect for the treatment of fractures, inasmuch as the curve compensates for the unequal weight of the trunk and extremities, so that, as the patient lies on the bed, the spring flattens out on an even plane, giving exactly the same result that is obtained by a fracture board or fracture bed, without the great discomfort. It is also of interest to observe that the latest model beds constructed by the French *Service de Santé* for their military hospitals have springs of this type.

The four-posted beds with the five iron frames that are formed around and above the patient make it, of course, a simple mechanical task to provide points of support for extension and suspension in any direction desired. As our experience with these beds has increased, we found that they were well adapted for the treatment of almost any injury of the extremities, from the simple suspension of painful arms or legs immediately after operation or injury, to increase either the comfort of the patient, or the facility with which painless dressings could be done, to the application of complicated extension appliances with many points of support for severe complicated fractures.

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Perhaps the simplest method of indicating the advantages of this fracture bed would be to describe *seriatim* the types of injuries and fractures which we have found it convenient to treat by means of suspension or extension in them. This includes likewise a discussion of the splints which we employed for this purpose, where either they or the method of using them differed from those which are in vogue elsewhere. Some of the apparatus employed at the American Ambulance has already been described by Fauntleroy¹—but a complete description of their beds and splints will appear in a forthcoming book by Miss Gassette, who is in charge of this department at the Ambulance. Our beds were all equipped with adjustable transverse supports with small rings that fitted into a series of notches so that firm support could be obtained at any desired point above the patient. Extension in a horizontal direction was obtained over the foot of the bed. In all points of suspension and extension a spring was inserted to make the pull elastic and act as a shock absorber. This adds greatly to the comfort of the patient. An ordinary fish scale or helical spring serves this purpose very well. Small muslin hammocks held by wooden spreaders proved of great value for simple suspension. It is difficult, however, to standardize this equipment except in a general way, inasmuch as the cases, especially in a military hospital, tend to present particular problems, each of which must be solved on its own merits. A study of the photographs and drawings accordingly will give a much clearer idea of this part of the problem than could be obtained by mere word description.

Suspension of the Arm.—We have found a number of conditions, such as extensive lacerated wounds of the arm, resections of the elbow, etc., which are extremely painful, on account of the motion during the dressing, in which fixation and suspension can be applied with great comfort to the patient and with added convenience to the staff. Figure 1 shows a case of this type where a wire splint is made to support the arm in a case of resection of the elbow for a combined arthritis and osteomyelitis following an explosive gunshot wound of the elbow-joint. The counterweight (Fig. 1) is so accurately adjusted that the arm maintains any position in which it is placed. In this way, the dressing can be done very easily without pain or discomfort to the patient. The wire splint was snugly bandaged to the arm and above and below the field of operation, which is left exposed and covered by a second bandage. With this apparatus the weight of the extremity is lifted entirely from

¹ Fauntleroy: Report on the Medico-Military Aspects of the European War. Washington, 1915.

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the bed, the position of the arm is automatically changed by movements of the patient and, at the same time, if the patient wishes to get up, the suspension apparatus can be detached and the splinted arm carried in a supporting sling. The possible variations of this method are numerous and obvious. It was found particularly satisfactory in a case of very extensive lacerations of the inner aspect of the arm reaching from a point just below the insertion of the deltoid to the middle of the forearm, in which the inner half of the elbow-joint was carried away by a shell fragment with destruction of the median and ulnar nerves and of the brachial artery. Every movement of this patient's arm was

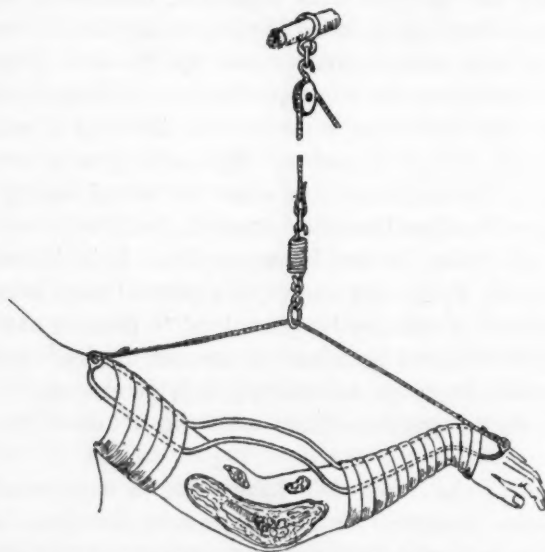


FIG. 2.—Suspension of the arm for lacerated wound about the elbow-joint, with a compound joint fracture.

exquisitely painful. The large wounds and the septic arthritis presented a problem which would have made dressings by the ordinary method so painful as to require an immediate amputation. This arm was supported by a wire splint which was bridged over the elbow-joint to afford space for the dressings and suspended with counterbalanced weights (Fig. 2). In this way, it was dressed with great comfort through a period of about two weeks until the lacerations had entirely granulated and the collateral circulation after obliteration of brachial artery was fully established. The arm was then amputated just above the elbow with atypical flaps. Had an immediate amputation been necessary it would have been performed at the level of the insertion of



FIG. 1.—Simple suspension of the arm for resection of the elbow.

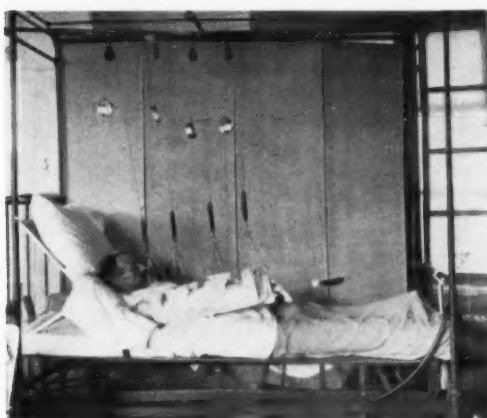


FIG. 3.—Horizontal extension and suspension for compound fracture of the middle of the humerus.

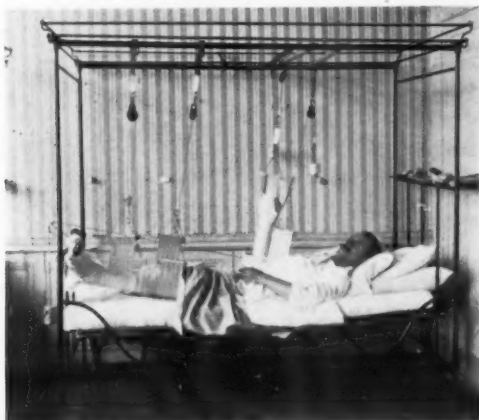


FIG. 4.—Angular extension for fracture of the humerus, suspension of the leg.

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the deltoid. It is in cases like these that simple suspension is not only a great comfort to the patient, but also a great convenience to the surgeon.

Fractures of the Humerus.—Vertical extension for fractures of the humerus is very simply applied on these beds. Adhesive straps are placed on the forearm alone or over the elbow up to the site of the fracture, which are connected with the pulleys on the overhead traverse so that the counterweights are carried off to some convenient point at the side of the bed. These should be heavy enough to maintain the extension during the movements of the patient. The problem is exactly similar to the almost universally used method of vertical extension of the thigh in children.

Horizontal extension for fractures of the humerus is likewise easily applied, either through the forearm or directly to the site of the fracture. In these cases, the extension weights are carried by a pulley over the foot of the bed, giving a direct pull on the humerus. At the same time, the arm is suspended in a series of hammocks and counterbalanced by weights above the bed. To distribute the support evenly along the arm, a padded basswood splint is inserted between the arm and the supporting hammocks. By taking down one or two of the latter, compound fractures are easily exposed and dressed. The arrangement of the apparatus in a case of this type is shown in Fig. 3.

The angular method of combined suspension and extension for the treatment of fractures of the humerus as employed by the American Ambulance is shown in Fig. 4. This combination of extension and suspension is obtained by counterweighting the arm so accurately that it rises and falls perfectly without effort as the patient moves, while the extension pull running to the foot of the bed maintains the alignment of the bone. The forearm is first placed in adhesive straps attached to a spreader which, in turn, is supported by a rope that passes through two pulleys, to a counterweight at the side of the bed. The extension is obtained by two adhesive straps extending to or just above the site of the fracture. The straps run to a spreader to prevent pressure on the condyles, from which a cord carrying the extension weight passes through a pulley at the foot of the bed. In cases where it is not easy to attach adhesive straps, as in certain compound fractures, the figure-of-eight bandage may be substituted to take the pull of the extension weight. To prevent angulation at the site of fracture, the humerus itself is supported in a broad muslin hammock, which is likewise counterweighted to bear in part the weight of the arm, the pressure of which can be distributed along the whole humerus by inserting a small padded

posterior splint of basswood. This rather complicated mechanism gives beautiful results, for the patient sits up, lies down, sleeps, with complete relaxation of the arm while the fracture is maintained in excellent position. Furthermore, the dressings of compound fractures are extremely simple and quite painless, inasmuch as the entire arm may be exposed for the dressing. We have not modified the use of this method except to insert helical springs in all points of support and extension to act as shock absorbers and render the action of the apparatus more comfortable to the patient.

In the treatment of fractures at the lower end of the humerus

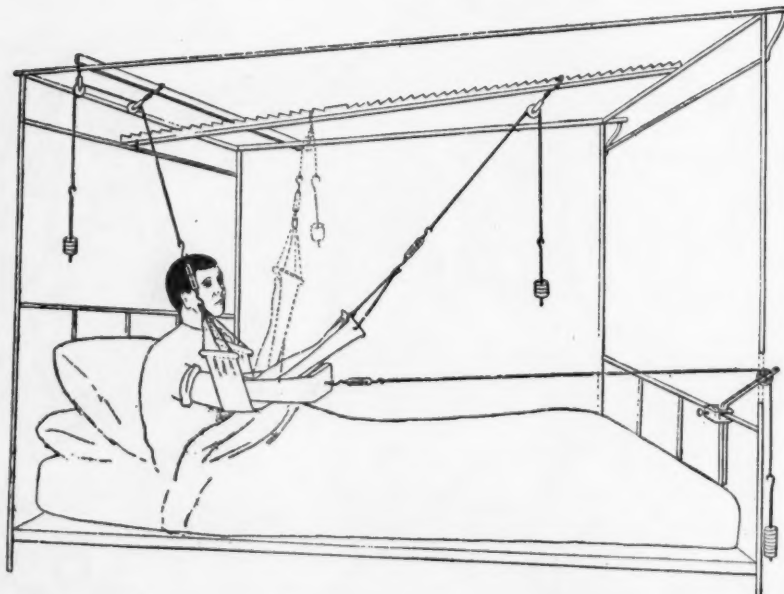


FIG. 5.—Suspension and extension for fracture of the humerus, involving the elbow-joint, with adjustable suspension of the forearm.

involving the elbow-joint, we have used a special adaptation of this method, which is shown in Fig. 5. The adjustment of the extension and suspension weights is exactly the same as in the case of fracture of the shaft, except longitudinal pull over the foot of the bed is exerted by the figure-of-eight bandage or through the forearm. The suspension cord of the forearm, instead of running to a fixed point in the overhead frame, is attached to a longitudinal bar provided with indentations, making it possible to vary this point of attachment at will. In order to prevent ankylosis of the elbow, the suspension point of the forearm is slowly changed twice or three times a day from a point near the foot

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of the bed to one near the head. In this way an arc of mobility of about 140° of extension to fairly acute flexion can be maintained during the process of the healing of the fracture.

In general, the great advantages of these methods of treating fractures of the humerus over the ordinary fixation systems that are usually employed are, first of all, the convenience of doing dressings in compound fractures, a feature of paramount importance in military surgery, and, finally, the mobility of the joints which is maintained during the process of union, for the wrist and fingers can be moved in the suspension straps, the elbows by the change of the overhead point of support and the shoulder by change of posture of the patient.

Suspension of the Leg.—There are numerous injuries of the lower extremity where the comfort of the patient is greatly increased by simple suspension of the leg with an additional appliance which permits both internal and external rotation. Among such injuries may be mentioned fractures that can be maintained in good position, compound fractures requiring frequent dressings, operations for osteomyelitis, painful injuries of the soft parts, etc.

The method of suspension with rotation is shown in Fig. 6, where Cabot splints are employed to secure fixation of the leg. In applying these splints, care is taken to pad the heel and popliteal space carefully, after which the splint is fixed in position by means of muslin bandages that skip the site of the compound fracture or injury. It is usually wise to reinforce this with a starch bandage. The area to be dressed is covered with a temporary removable dressing. For this purpose, small Scultetus binders are very convenient and economical. The wound may be exposed and the inner dressings changed without moving the extremity. These binders may be used for several days before they have to be changed. The splint is then slung in two hammocks, which are kept extended by two round pieces of wood, in the ends of which are two holes fixing the supporting ropes. By means of a ring connection, a second rope is attached to one end of the hammock, which passes through a pulley on the frame above. This is then fixed to the opposite end of the hammock by a loop controlled by a tent block, making it adjustable. By means of the hammock, the leg is lifted from the surface of the bed and the patient finds that he not only can swing the foot laterally by motions at the hip-joint, but also can obtain internal and external rotation by the play of the ropes attached to the ends of the hammocks through the pulleys. The springs that join the latter to the transverse supports give a certain elasticity that prevents any jarring during the motions permitted by the apparatus. The mechanism and

degree of rotation are admirably shown by the detail photographs in Fig. 7.

We have had certain cases with compound fractures at or near the ankle-joint where the lower hammocks interfered with the removal and application of the dressings. These cases can be treated by the special form of splint shown in Fig. 8, where the extension of the sides below the foot-piece permits the support of the lower rotation ropes without the use of a hammock. The region of the ankle may thus be dressed without disturbing the suspension at all. In some cases where the condition requires prolonged suspension, the heel is apt to get sore. This may be prevented by the use of a suspension weight of about one pound attached to the foot by means of plantar and dorsal adhesive

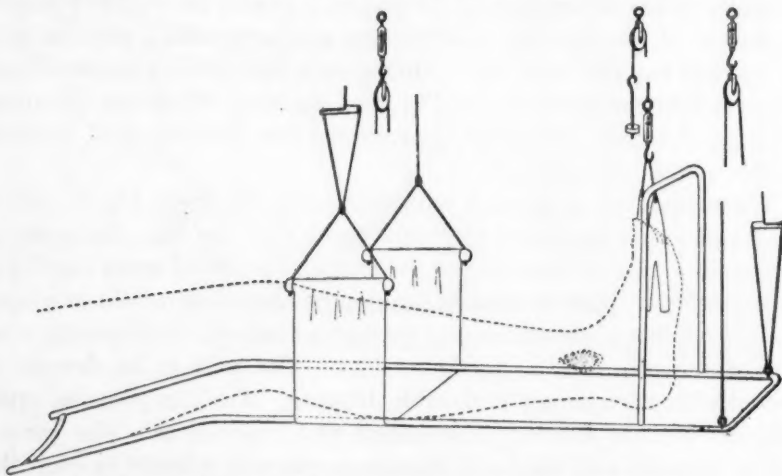


FIG. 8.—Modified Cabot splint for suspension and rotation of the ankle.

straps. This trifling weight is apparently sufficient to relieve the heel of painful pressure. The application of this counterweight is shown in Fig. 8. It is a little short of astonishing to observe how a painful extremity or a compound fracture, after being fixed upon a Cabot splint or upon a round gutter splint, may be made perfectly comfortable in a few moments by suspension in this apparatus, which allows free motion of the hip and particularly permits the patient to sleep on either side, owing to the power of rotation. The patient soon learns to adjust the tent blocks himself, which permits him to raise or lower the legs at will, and this gives the added comfort of another postural change besides the rotation. This type of treatment applies to wounds or injuries of the soft parts, osteomyelitis, simple fractures which are in good position, or fractures of one bone of the leg in which the other acts as a splint,



FIG. 6.—Apparatus for suspension and rotation of the leg.

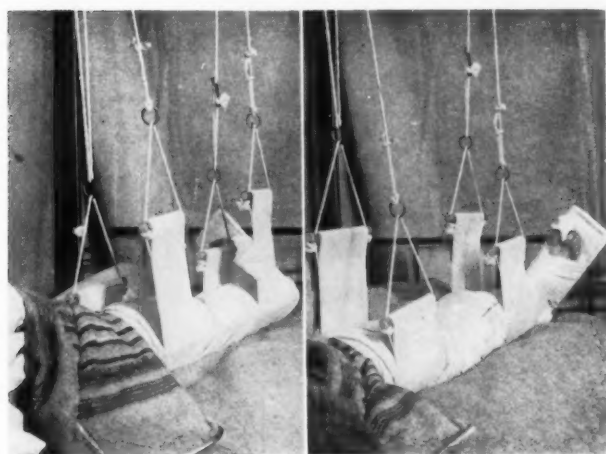


FIG. 7.—Detailed photograph showing the operation of the rotating mechanism.



FIG. 9.—Railway splint with self-contained extension appliance for fractures of the leg.



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but not for fractures requiring extension. By simply slipping the hammocks off the splint, the patient can be transferred to a wheel-chair, and resuspended on his return to bed.

Fractures of the Tibia and Fibula Requiring Extension.—After having found that the patients had so much comfort in the simple suspension of the leg, an attempt was made to devise a splint which not only would permit of suspension and rotation with free movement at the foot, but would also have a self-contained extension apparatus at the same time. A splint of this type is shown in Fig. 9 upon a patient

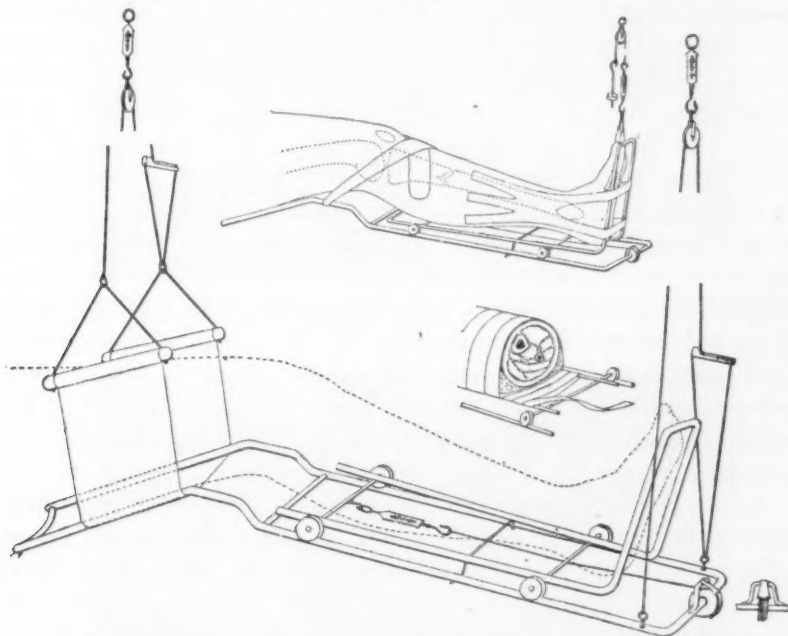


FIG. 10.—Details of the construction and application of the railway splint.

suffering from severely comminuted fractures of both bones of the leg with a gas bacillus infection in which the operation for better drainage of the infection had necessitated the removal of numerous loose fragments of bone.

This appliance was named by the patients the railway splint, because the foot and portion of the leg containing the lower fragment are carried upon a small carriage which runs upon the main part of the supporting splint as a track. The details of the apparatus are better shown in the line drawing (Fig. 10), together with the method of its application and support.

The carriage is covered like an ordinary Cabot splint. This is

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padded and the foot is bandaged to the carriage, around the base of which the extension straps are joined, care being taken to protect the malleoli from pressure. The carriage should extend to a point just above the fracture. It is then placed upon the tracks of the main part of the splint, which is adjusted with a slight bend at the knee and which, in turn, is bandaged and padded at the knee like an ordinary Cabot. Adhesive straps for counter-traction are placed at convenient points near the ends of the upper fragments and attached to the side of splint. The entire splint is then suspended, either according to the method shown in the photograph (Fig. 9), in case rotation is not desired, or like that in the drawing, if the leg is to be allowed to rotate during the extension. The patients were allowed to have this detail arranged according to their own desires. The extension is exerted by a cord attached to the carriage through a spring. This is wound up on a ratchet-wheel at the foot of the splint. In making this attachment of the extension cord, a fish scale is much preferred to an ordinary helical spring, owing to the fact that a rough idea of the pull used in the extension may be determined by the readings of the scale. In some cases the two-point support is changed to a single-point, with a pulley, so that the patient himself, by adjusting the tent block, can vary the position of the splint in the longitudinal direction, as is shown in Fig. 9. When desired, the splint may be detached from the suspension bed and the patient allowed to go about in a wheel-chair, the self-contained extension operating very well under these circumstances.

Another type of combined suspension and extension apparatus is shown in the patient at the right in Fig. 11 and in the detailed drawing in Fig. 12. In this case, the patient was shot directly through the leg, with a wound of entrance on the anterior surface and a wound of exit in the calf behind. Both bones were badly comminuted and the fracture was infected with gas bacillus. The drainage was largely through the posterior wound.

In order to obtain a form of splint which would permit the dressing in this case, without motions at the site of the fracture, the leg was put up in a Hodgen's splint with a single point of suspension. Extension is obtained by means of two cords attached to adhesive straps on either side of the leg at the level of the lower fragment, that pass through pulleys at the foot of the splint, as is shown in Fig. 12. A helical spring inserted in this cord gives a constant elastic tension. Counter-traction is obtained by adhesive straps at the level of the upper fragments, which are attached to the sides of the splint. In this way the leg is comfortably suspended from the bed so that the dressings could be done without



FIG. 11.—At the right, Hodgen's splint with self-contained extension appliance for fractures of the leg. At the left, Hodgen's splint for fracture of the femur with overhead inclined trolley.

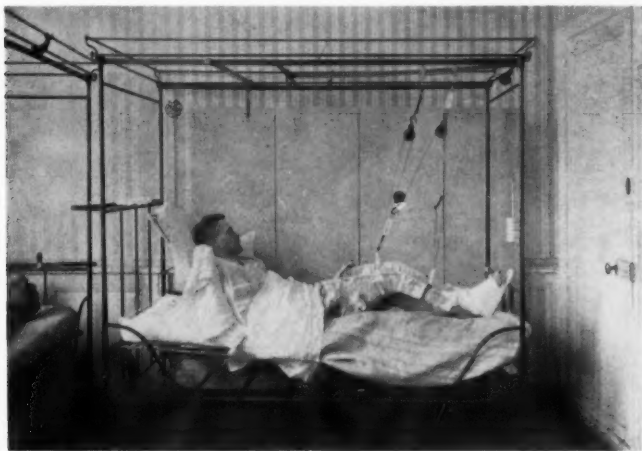


FIG. 13.—Hodgen's splint with overhead trolley for fracture of the femur.

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moving the fracture, but at the same time a constant extension was applied during the process of healing. This proved to be an extremely comfortable and convenient appliance. A stirrup is applied to prevent a toe-drop.

Fractures of the Femur.—Fractures of the femur below the level of the trochanters are conveniently treated by the Hodgen's splint. The adjustment of these splints is shown in the patient at the left in Fig. 11. The combination of suspension and extension for these splints is arranged by means of an inclined overhead trolley, with the inclination towards the foot of the bed to facilitate the action of the extension weights. This allows the patient a considerable amount of mobility, but

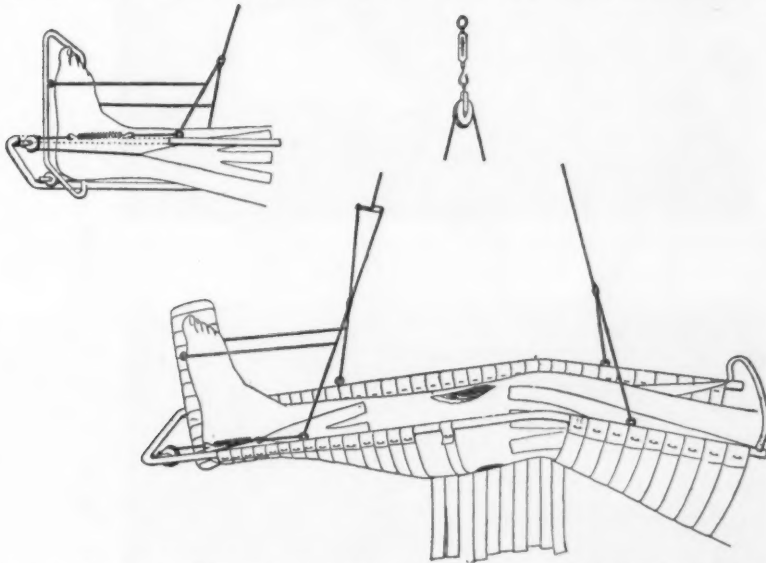


FIG. 12.—Details of the Hodgen's splint with self-contained extension for fractures of the leg.

at the same time exerts a constant extension upon the fracture. Dressings of compound fractures are easily done in the Hodgen's splint. In most cases not more than ten pounds of extension is required to hold the fracture in good position. An earlier arrangement of this method is shown in Fig. 13, which, however, is not as convenient as the inclined trolley. Another variation is shown in Fig. 14, where the splint, equipped with a foot-piece to prevent toe-drop, is elevated from the bed in a two-point fixed suspension. By this method, the extension is applied directly over the foot of the bed from the extension straps at the side of the leg. While it is quite efficient, the apparatus, however, is not as comfortable as the trolley system outlined above, owing to the

fact that the foot is fixed by the extension card, thus limiting to a greater extent the mobility of the patient. With the trolley system of suspension and extension to a common point above, the foot springs free, and adds greatly to the comfort of the patient.

Supracondylar Fractures of the Femur.—These fractures may be treated by a railway splint, the carriage of which extends to the level of the lower fragment above the knee, the portion of the splint containing the track reaching up to the pudendal fold. Counter-traction anteriorly may be made in these cases to counteract the tendency of the lower fragment to posterior dislocation by means of a hammock which

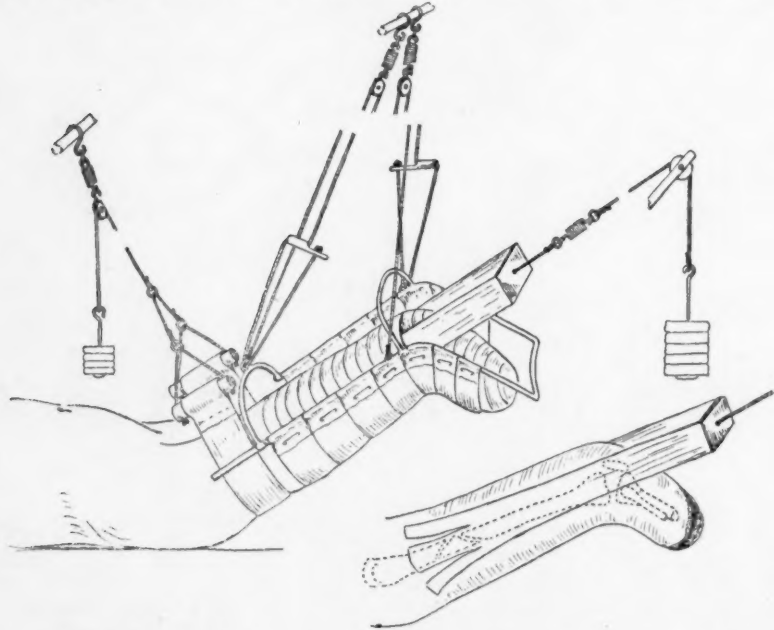


FIG. 16.—Suspended right-angled splint for fracture of the femur and open amputation of the leg.

runs to a special point of support above the bed. Another satisfactory method of treatment is shown in Fig. 15, where the suspension and extension of the leg and lower fragment are obtained by means of Cabot splint swung in hammocks to an overhead trolley, the major part of the extension being obtained directly from the leg over the foot of the bed, aided by the slight pull on the trolley system above. The upward counter-traction on the lower fragment is excellently shown in this photograph.

There are occasionally special fractures of the femur which require specially constructed splints. Such an instance is shown in Fig. 16,

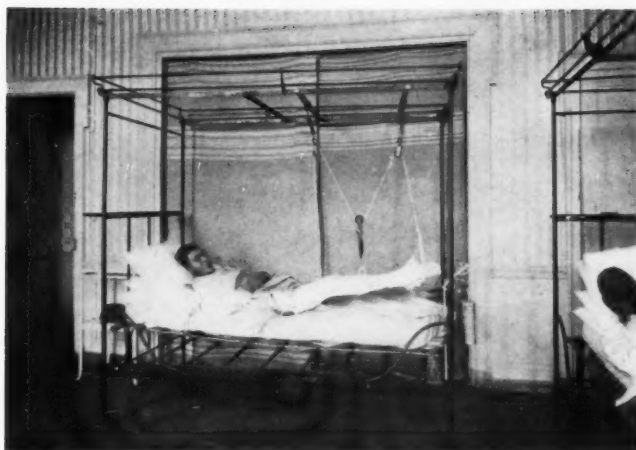


FIG. 14.—Hodgen's splint with overhead suspension and extension applied directly from the foot.

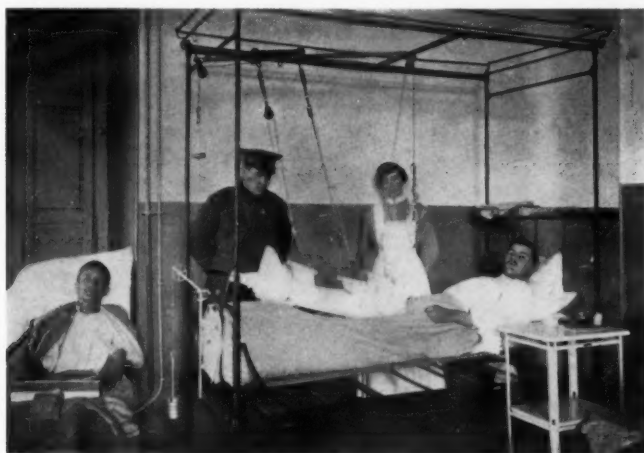


FIG. 15.—Method of extension and suspension for supracondylar fracture of the femur.

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where the patient had a badly compounded fracture of the leg, necessitating immediate amputation, together with a comminuted fracture at the junction of the middle and upper thirds of the femur. This was suspended in a right-angled splint, permitting the dressing of the open amputation below, while the suspension elevated the lower fragment of the femur in alignment with the upper to overcome the pull of the iliopsoas muscle. The extension was applied by means of adhesive straps in direct line with the femur, according to the principle used in the Steinmann nail extension. Nail extension, however, could not be employed in this case, owing to abrasions about the knee, which rendered probable an infection of the femur. It is questionable whether the Steinmann nail extension has any advantage over the method of treating fractures of the shaft of the femur by means of the right-angled suspension splint, if we exclude the group where operation is indicated for malposition and shortening after union has occurred. The counter-traction exerted by the hammock in this case was to prevent angulation at the level of the fracture, when, owing to the abraded condition of the skin, the extension was reduced immediately after the formation of the soft callus.

Fractures of the Trochanters and the Neck of the Femur.—The same criticism which applies to Buck's extension in the fractures of the shaft applies also to this method in the treatment of fractures of the upper end of the femur. Mechanically it is ineffective, inasmuch as most of the weight which is applied to the extension straps is lost in the friction of the leg over the mattress and never reaches the site of the fracture. The use of heavy weights on the extension straps leads to frequent abrasions of the skin and often to effusions into the knee-joint. Some method of fixation must also be employed to correct the tendency to eversion. This lost force can be eliminated and the same result obtained by the combination of suspension and extension through the use of a long Cabot splint reaching to the pudendal fold, which simply elevates the leg for a short distance from the bed. The extension can then be obtained directly over the foot of the bed, as is shown in the accompanying sketch (Fig. 17). In this way, not only is the loss by friction eliminated, but this very factor is utilized to reduce the pull which is exerted directly upon the skin through the extension straps. In these cases the supporting bandage which holds the leg in the splint, as well as the weight of the leg itself, likewise plays a part in the distribution of the extension weight to the site of fracture. The Hodgen's splint with the free foot is not a desirable method of treating the fractures of the neck, owing to the fact that it permits too much motion at the site of the fracture. The Hodgen's adjusted with foot extension,

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as shown in Fig. 14, or the long Cabot, immobilizes at the hip just as well as Buck's, but directs the extension pull more efficiently to the site of fracture, owing to the elimination of the friction. In my experience, results which were previously obtained by the application of twenty to twenty-five pounds in a Buck's extension can be given by an application of eight to twelve pounds by means of the Hodgen's or the long Cabot splint with foot extension.

There are occasionally atypical fractures for which these suspension and extension methods are particularly suitable. One such instance entered the hospital at Passy with a compound comminuted intertro-

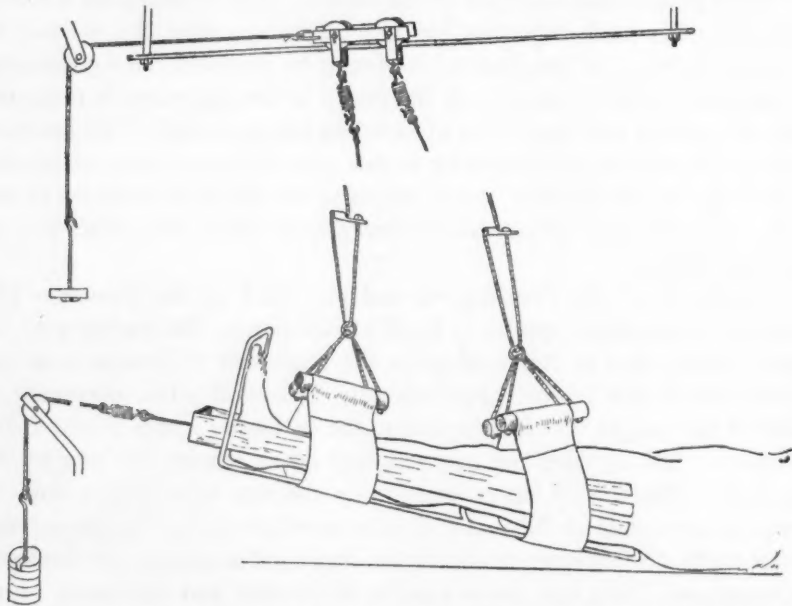


FIG. 17.—Method of applying a long Cabot splint as a substitute for Buck's extension.

chanteric fracture of the femur. Either the German ball or a fragment of bone had occluded the femoral artery, resulting in gangrene of the leg, extending to a point about 10 cm. above the knee. Inasmuch as exarticulation at the hip yields such bad results from the standpoint of the application of an artificial leg, it was thought desirable to make an effort to save the upper two-thirds of the thigh, to which the artificial limb could be more easily adjusted. Accordingly, a circular amputation was done just above the line of demarcation. The projecting end of the femur was perforated and a wire passed through it, to which extension could be applied over the foot of the bed. The stump was supported in a counterweighted hammock, facilitating the dressing of the amputation

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and the wound of entrance just behind the great trochanter in the lateral aspect of the buttock. Fig. 18 shows the application of this type of apparatus. The extension in this case is applied directly to the bone, as in the case of the Steinmann nail extension. This patient was extremely comfortable, could be dressed easily, and healed with great rapidity. There was, however, a persistent osteomyelitis of the upper

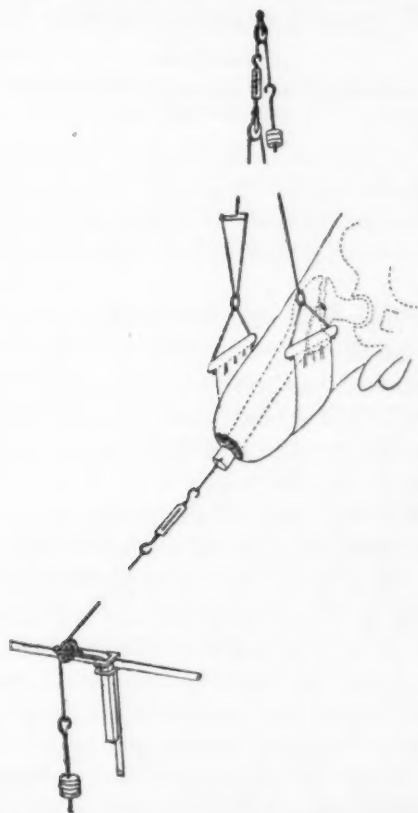


FIG. 18.—Suspension and bone extension for a compound comminuted intertrochanteric fracture of the femur with amputation at the junction of the middle and lower thirds of the thigh for gangrene.

end of the femur and a very abundant callus at the time I left the hospital.

Further study and experience with these methods of suspension and extension are sure to lead to technical improvements and a wider application of the principles involved. It has seemed, at this time, worth while to record our experience with the fractures thus treated, particularly to emphasize the convenience of the mediæval bed, a copy of which we hope will soon be placed on the American market.

FOREIGN BODIES IN THE RESPIRATORY TRACT*

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WHENEVER a condition has been shown to be amenable to successful treatment, although that condition has long been recognized as a distinct pathological entity, it receives renewed attention from the part of profession most in contact with it particularly, and from the profession in general, later on.

This has been shown to be the case with one abdominal condition after another—too numerous to mention—and has been observed in other regions, particularly the chest and its organs of approach.

This evening we are concerning ourselves with foreign bodies in the larynx, the trachea, the bronchi and the terminal mechanism for the interchange of oxygen, viz., the lungs.

These objects all at one time or another have connection with the air current and act differently in the tissues from bodies which are buried completely. Any tendency to encapsulation means encapsulation with an opening at one or more points; and this capsule forms more the wall of a cavity in which the body lies free and in the midst of pus which is evacuated from time to time, than a true encapsulation.

History.—Going a little into the history of this class of cases it appears that the surgical attack of foreign bodies in the upper air passage dates back as far as Hippocrates who devised catheterism or intubation of the larynx in order to relieve the suffocation. Poulet¹ says the idea of opening directly into the passages was first advanced by a "Roman physician named Asclepiades, who had no opportunity of putting it into practice and was long exposed to the raillery of his contemporaries and successors."

Transverse section between two rings of the trachea was proposed by Antylus, Oribasis, Aetius and Paul of Egina, because of the then current idea of the impossibility of the recovery of divided cartilages.

Habicot prior to 1824 pointed out the way toward the rational employment of bronchotomy in cases of foreign bodies.

* Read before the New York Surgical Society, February 9, 1916.

FOREIGN BODIES IN THE RESPIRATORY TRACT

According to Brünings and Howarth,² "the systematic examination and treatment of the trachea and bronchi by the peroral introduction of straight tubes was initiated by Killian in 1896. After being successfully applied in a case of a foreign body lodged in the bronchi it was recommended in 1897 as a clinical method."

The names of Killian, Von Eicken, Brünings, Chevalier Jackson, Mosher, Ingalls, Yankauer and many others are all familiar in connection with this subject.

Many of these investigators are laryngologists. But it is from the general surgical stand-point that we are interested in this subject this evening.

Anatomy.—In the laryngeal portion of the respiratory tract the vocal bands constrict the lumen. Between the false cords above and the vocal bands is the ventricle of the larynx. In this recess an object often finds lodgement.

The next stopping place is at the level of the cricoid where the lower end of a pin or an elongated nut meat may become caught; as in two cases of ours.

Having passed the upper part of the respiratory tract the next point of arrest will be at the bifurcation of the trachea, if the body is too large to pass into one of the main bronchi. This site rarely arrests the object, however, as bodies small enough to pass the cords will slip into the bronchus. The right bronchus from its large size and the position of its opening is the one most frequently entered (Fig. 2). The spur dividing the two bronchi is situated to the left of the median line of the trachea and serves to direct a rapidly moving object into the right bronchus.

Less frequently it may pass into the left main bronchus. When the body has passed into either main bronchus its next point of arrest is either in the eparterial bronchus on the right or the hyparterial bronchus on the left or in the "trunk bronchus" on either side. The latter is fortunately the more frequent place. The trunk bronchus may be called the continuation of the right or left main bronchus after giving off the branches to the upper lobes.

A smaller body may penetrate to the divisions of the "trunk bronchi," the various lobe bronchi, and their subdivisions.

Classification of Foreign Bodies.—The foreign bodies found in the respiratory tract may be divided according to their composition into mineral and metal and organic objects.

Most of the mineral or metal objects on account of their density are impervious in a greater or less degree to the Röntgen rays.

Of the organic objects those which have a certain percentage of calcium or other heavy salts are detected by the X-ray (pieces of bone and teeth).

Again, foreign bodies may be divided according to their shape into round, elongated, irregular and sharp-cornered.

The most to be dreaded are the organic objects which are round and smooth and can swell rapidly,³ such as seeds and beans, and those which break up easily, such as nut meats. Pieces of bone and pieces of tissue are also to be placed in the dangerous class. By far the most easily recovered ones are the metallic bodies.

The most frequent occurrence of foreign bodies in the air passages is with children. Brünings says 69 per cent. of foreign bodies occur in children up to twelve years of age. The greatest frequency is at about the age of two years.

All of our personal cases have occurred in children, except one, that of the soldier who inhaled a badge fastener at the age of seventeen years and in whose lung it remained for six years (Fig. 3).

So this particular disorder may be called a disease of childhood and youth.

Case of F. S.,* twenty-four years of age. Patient was admitted to the medical service of St. Luke's Hospital under Dr. Austin W. Hollis, suffering from cough and with a foul expectoration. Seven years ago he had a thoracotomy done in London for what appeared to be an empyema. The wound healed in five or six weeks and there has been no discharge since. The week previous to his admission he expectorated large amounts of foul-smelling pus, although coughing no more than usual. The sputum was greenish-yellow and there was never any blood in it. In short, he gave a clinical picture of a patient suffering from bronchiectasis.

On January 30 he was radiographed by Dr. Truesdale, and this showed the presence of a foreign body. On January 31 and on three later days he was radiographed by Dr. L. T. LeWald, who confirmed the diagnosis of a foreign body, and, by taking exposures at right angles, showed the true nature of the object, namely, that it was much the nature of a cotter pin. On going over the anamnesis, it was brought out that seven years before he had "swallowed" a badge fastener which he thinks he was holding in his mouth when a comrade slapped him on the back. (The badge fastener was used to fasten the regimental badge to his uniform.)

* This case was presented before the New York Surgical Society, April 28, 1915, and was reported in the October, 1915, number of the ANNALS OF SURGERY.



FIG. 1.—Röntgenogram of bronchial tree of female child, nineteen months of age. Bismuth mixture injected through bronchoscope. Consolidation of right lung prevented complete injection. (Lynah and LeWald.)

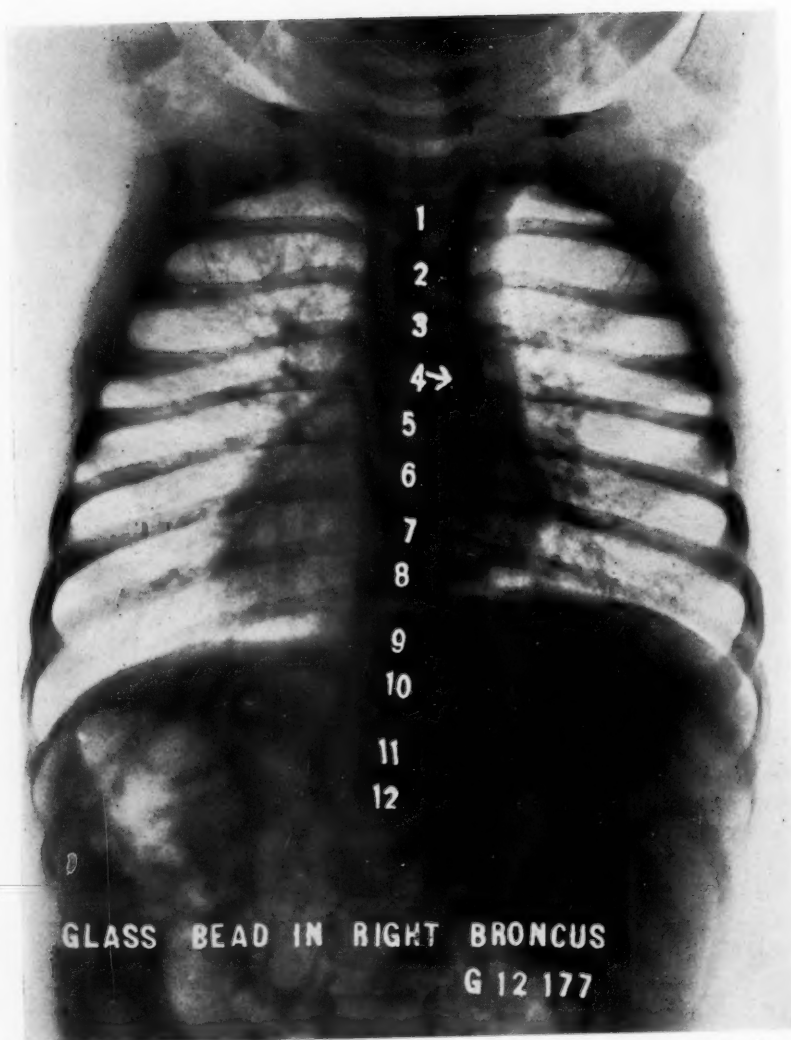


FIG. 2.—J. P. Bead from necklace lodged in right bronchus. The bead was made of opaque blue glass.

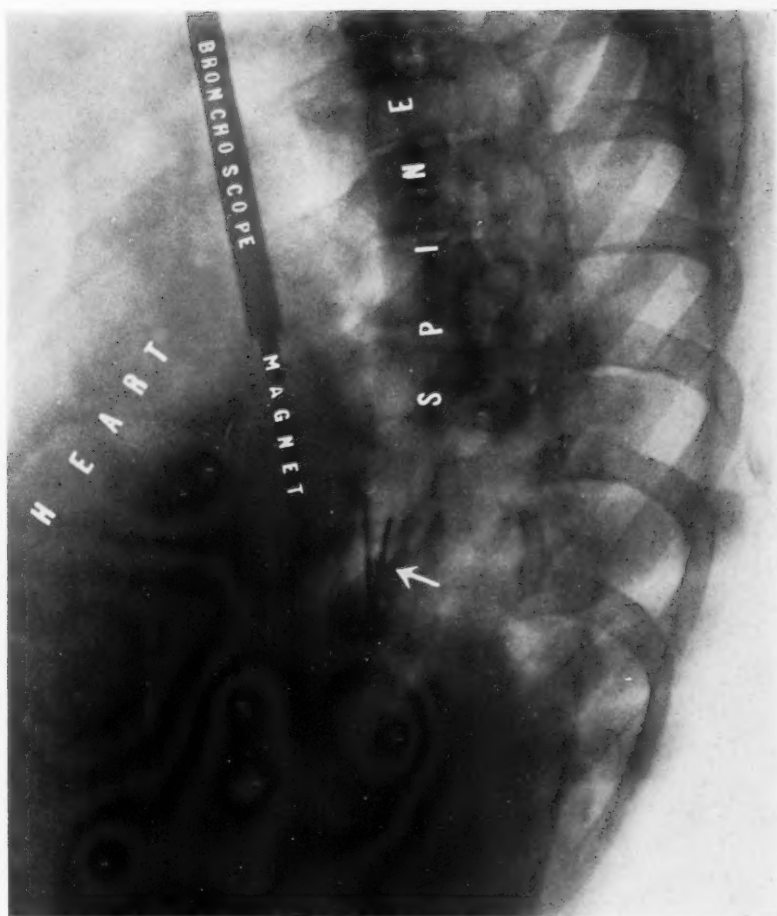


FIG. 3.—Röntgenogram of chest of F. S., showing foreign body, badge fastener or cotter pin, and showing bronchoscope and through it magnet passing into cavity where object lay.



FIG. 4.—H. G. Fish bone lodged in trachea. The shadow corresponds in size to the bone which was expelled through the tracheotomy tube.

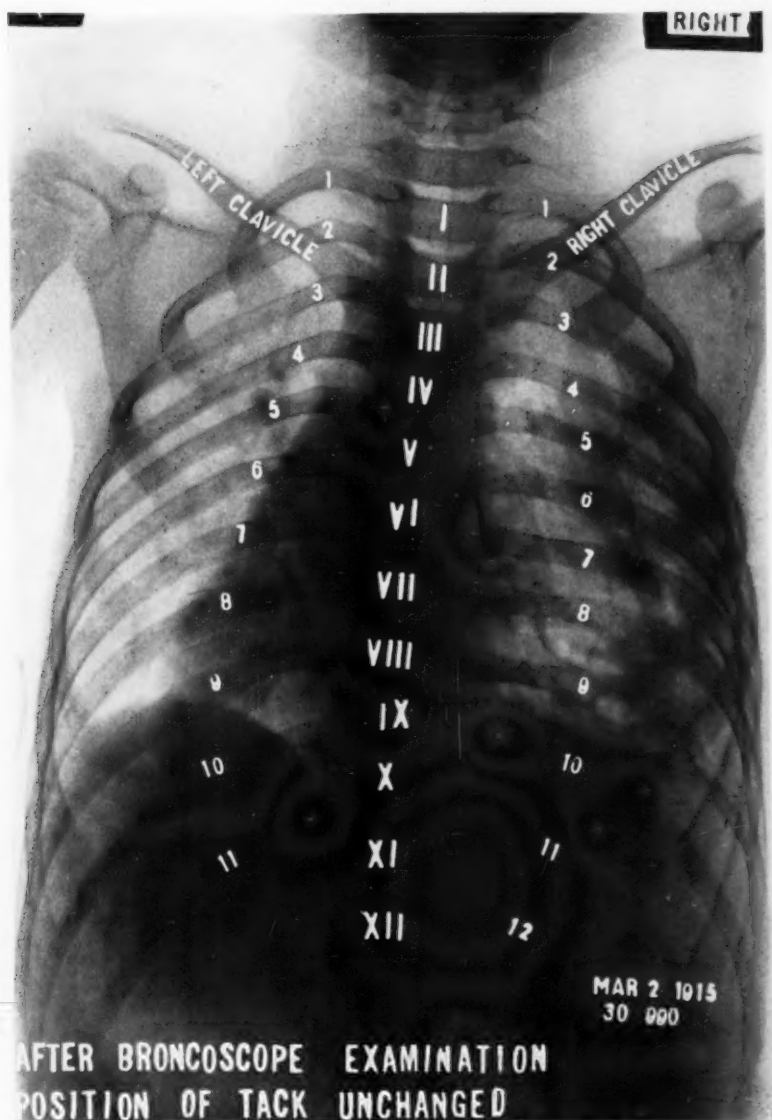


FIG. 5.—Röntgenogram of chest of F. B., showing foreign body, tack, in abscess cavity communicating with right bronchus, after an attempt had been made to reach it orally. It was later removed by a lower bronchoscopy.

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FOREIGN BODIES IN THE RESPIRATORY TRACT

He was transferred to the surgical service March 20, 1915. Repeated attempts to find the foreign body were made by upper bronchoscopy, and, although the object could not be seen, in one of these attempts, the presence of a cavity was demonstrated, and in coöperation with Dr. Le Wald, the nearness of the end of the bronchoscope to the foreign body was shown. Later this helped to locate the pin by measurements and by the X-ray. On March 29 the bronchoscope was introduced and the magnet introduced through it, with the hope that the foreign body might be of iron; then the radiograph was taken. This showed the magnet to be within an inch of the foreign body, but there seemed to be no tendency to attract it. It was decided then that it would be better to go in through the back and remove it in this way.

On April 1 three shot were placed on the skin as a marker and a piece of half-inch-mesh wire netting. Radiographs were then taken by Dr. LeWald in two directions. The distance of the foreign body was measured and found to be in one direction 6 cm. from the shot and lying just in front of the rib.

Operation (April 1, 1915).—Under local anæsthesia, two ribs were removed by Dr. Green. The lung was found adherent to the parietal pleura, as was expected, and found to have a hard spot in it. At the suggestion of Dr. Martin this hard spot was entered with a needle and found to be the wall of a cavity. The needle was followed with a pair of dissecting scissors and upon opening them the cavity was widely opened. A pair of Blake's gall-stone forceps was then introduced into the cavity and the foreign body grasped and brought out. A tube was then placed into the lung and the wound was partially closed, leaving drainage.

The interesting points are that the X-ray located the badge fastener; repeated attempts to see the object through the bronchoscope failed, but the bronchoscopic method furnished the following information: That there was something causing granulations which filled up the right terminal bronchus. Second, that there was a cavity at the end of the right terminal bronchus, $2\frac{1}{2}$ inches in length. (This was proved by passing a probe through this scope and feeling it "give" as it passed the opening of the cavity.) Therefore, the foreign body probably lay loose in this cavity. Third, that the foreign body lay well toward the base of the lung, behind, and just anterior to the rib. Fourth, that the most of the cavity was rather behind the bronchus than just at the end of it.

The convalescence has been rapid although not complete. The character and odor and quantity of the sputum have changed markedly for the better, and the patient looks the picture of health.

It has been impossible further to report on this case, as the

patient while crossing to England on the Lusitania was drowned at sea.

Classification of Cases.—The reaction of the organism to the various foreign bodies differs with the length of time of lodgement.

Recently inhaled bodies produce at first but little reaction beside that of reflex coughing and dyspnoea. This class of cases may be termed the immediate cases.

Patients in whose lungs the foreign body has found lodgement for a longer time present the complications which make their condition that of extreme severity. They may be classed as deferred cases.

This differentiation in the cases is important throughout the whole tract, but nowhere as important as in the deeper structure of the lung, where the late manifestations may be those of infection, either acute and local, or more chronic, with the changes in the general system due to absorption.

The Means of Diagnosis.—The first point in making a diagnosis is the history. This is often of an indefinite nature, especially in cases of long standing, and the essential points may be forgotten until the later symptoms may lead one to suspect the presence of a foreign object, when one again goes over the history with the patient's family (as is illustrated in the case of F. B.).

Case of F. B.* Patient was admitted to the surgical service of St. Luke's Hospital, special to Dr. William A. Downes, on December 16, 1914, suffering from a cough and fever. He was then six years of age. One month prior to his admission he began to cough, but was not ill enough to go to bed. His cough continued and grew worse, and five days before admission he grew markedly worse. He had lost weight and complained of pain in the right chest. Upon admission, he gave the signs and symptoms of a right empyema, for which he was operated upon immediately. As his condition did not clear up in the usual time, he was radiographed by Dr. Le Wald and the presence of an upholstery tack in the region of the right terminal bronchus was discovered as the cause of the delayed convalescence. Upon questioning the father more closely, it was recalled that the child "swallowed" a tack two years previously, but this had been forgotten. He was turned over to Dr. Green for bronchoscopic examination and for removal of the foreign body, if possible.

The physical findings at that time were dulness over the right chest posteriorly from the angle of the scapula to the base, with diminished voice and breath sounds and numerous large, moist râles. An attempt was first made by means of an electromagnet,

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introduced into the persisting sinus in the right chest, to draw out the tack, but this failed. Repeated bronchoscopic examinations through the larynx showed granulations at the end of the right bronchus with pus exuding. The cavity which proved later to be surrounding the tack was not entered at this time. A tracheotomy was performed on March 2, and seven days later the boy was bronchoscoped through the tracheotomy wound. At this time the bronchoscope passed nearly to the cavity and forceps could be pushed into the cavity for two inches.

It was considered that part of the tack at least must be made of iron and so a small electromagnet, which passed through the smallest size of bronchoscopic tube, was made, and this was introduced through the tube ten days later, under combined ether and cocaine anæsthesia. The tack was mobilized by this means and brought up into the end of the bronchoscopic tube with the head of the tack across lumen of the tube. An attempt to grasp it failed and the procedure was then at once repeated. This time it brought the point of the tack into the bronchoscopic tube. It was then grasped by special forceps through the tube and, resistance to its removal being felt, a steady traction was made upon it as the child breathed, and little by little the resistance was overcome and the bronchoscope and the forceps through it grasping the tack were removed simultaneously. There was some bleeding from the granulations. A suction tube was at once introduced to remove this, and in a moment the bleeding stopped.

The child since then has been steadily improving. The character of the expectoration which at first was fetid and green has changed to a white expectoration without odor. The amount of expectoration has diminished as well as the amount of drainage through the chest. The child is gaining flesh.

The interesting points in the case are that the foreign body had remained in the lung for two years and that there was no attempt at encapsulation. It lay in a cavity in the lung at the end of the right terminal bronchus and this cavity contained about an ounce of pus.

The later history of F. B. showed his health greatly improved while the side was open and draining, but with loss of flesh and color when it closed. The expectoration also again became foul and thick and reverted toward his previous condition, before removal of the foreign body.

He was readmitted to the hospital, August 3, 1915, and on August 20, 1915, a thoracoplasty with excision of the seventh and eighth ribs, under combined general and local anæsthesia, was performed. The pathological findings at this time were as follows: There was a sinus tract leading from a scar in the skin through the

seventh rib. The seventh rib had a large spur attaching it firmly to the sixth rib. The sinus tract led down to the dome of the diaphragm and also apparently connected with the bronchus. The pleura was but imperfectly adherent to the chest wall and the pleural cavity was opened at this time but was closed by suture.

On December 28 the external wound was again healed.

This condition of affairs is more apt to obtain when the object has found lodgement in the smaller bronchi and there has become fastened with no further displacement. An object which remains in such a position after the initial symptoms of severe cough and varying dyspnoea may give rise to comparatively little disturbance until some of the deferred phenomena have begun to show themselves.

On the other hand, an object which remains stationary in the larynx or trachea will probably give rise to more or less constant symptoms, especially those of dyspnoea, either from occlusion of the air interchange or due to a continuous reflex inhibition of respiratory movements. "If the interference with the entrance of air is not great the foreign body will be tolerated and particularly if fixed give but few symptoms."⁴

Again, if an object has been arrested at the tracheal bifurcation or in the right or left main bronchus, it may be of such proportions that it is neither impacted nor coughed out, but acts as a movable body, which may be blown about by the current of air and find impingement upon different parts of the mucous membrane, each time causing a fresh paroxysm of coughing.

Finally, any symptom for which the cause is obscure must, among other things, be considered as possibly due to a foreign body. The presence of a localized bronchitis, a pneumonia which fails properly to resolve, a lung abscess, a bronchiectasis, or a chronic empyema should lead our attention to the possibility of the complication of a foreign body and one should at once proceed to a further means to clear up the diagnosis.

The most important next step should be to have the patient submitted to a röntgenologic examination. This is important in immediate cases and also in those of the deferred type.

Chevalier Jackson has said that it is his belief that almost all kinds of foreign bodies can be detected by a properly taken röntgenogram.⁵ This is in a large measure true; but it has been our experience that such a radiograph may not give strong enough proof in itself of the existence of an extraneous object (Fig. 4), but may be of assistance in suggesting the location of the foreign body and become a record when one has finally recovered the object.

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It is difficult to conceive how a seed or a nut meat in the bronchus can be of sufficient density to betray, in the immediate cases, its location.

After the Röntgen-ray and of equal importance, but secondary in sequence from a diagnostic stand-point, comes the direct inspection of the larynx, trachea and bronchi by means of the bronchoscope. One is fully aware that he may have laid himself open to criticism in placing this procedure second in point of time to the röntgenologic examination, but the reasons for doing so are the following:

First, the Röntgen-ray examination requires but little time.

Second, it may be done without an anæsthetic (which in some cases is necessary).

Third, it is of no discomfort to the patient.

Fourth, it may materially shorten the following bronchoscopy by giving the operator a distinct indication of the portion of the bronchial tree or entire respiratory tract to be investigated.

All these indications may be altered in certain cases and the examiner who is familiar with bronchoscopic work is the best judge in each particular case as to which shall precede the other.

Treatment.—In the matter of treatment of these cases, Garré and Quincke say: "When we consider the not infrequent unfortunate consequences of foreign bodies which have not been removed (hæmoptyses) and the most unfavorable prognosis of operations on the secondary pulmonary suppurations caused by them, the necessity of an earlier active therapy needs no stronger argument." ⁶

With them it is one's privilege to agree as also with Von Eicken, who says: "Whilst in earlier statistics the mortality in cases of aspiration of foreign bodies showed a terribly high percentage, at the present time it is an exception for anyone to die from such a calamity if suitable treatment is available." ⁷

The treatment of the immediate cases and of the deferred cases differs markedly, both as to procedure and as to the ultimate outcome. An immediate case which is treated unsuccessfully at the first sitting, or if necessary sittings, becomes then a deferred case and passes at once into the category of serious illnesses.

It is not the purpose of this paper to go into the minute and tedious details of bronchoscopic technic, but rather to indicate what in our opinion are the salient points of the bronchoscopic procedure, which entails, to a large degree, the sum of immediate treatment.

In the immediate cases the object of the treatment is to get at the foreign body and remove it through the natural passages. (This paper is not dealing with foreign bodies forced into the respiratory tract by

solution of continuity of the chest wall.) To do so one must first have a suitable bronchoscope and then be sufficiently familiar with its use to introduce it successfully. It can be done with local anaesthesia or under general anaesthesia or by the aid of a combination of both. Children in our experience require a general anaesthetic for the introduction of the tube through the larynx. A combination of general and local anaesthesia with preponderance of the latter may be used if the tube is to be introduced through a tracheotomy wound.

Adults submit to upper bronchoscopy under local anaesthesia with very little discomfort.

In immediate cases if the first or second trial prove unsuccessful, especially in fragmented objects of an organic nature, a tracheotomy should at once be done with the introduction of the bronchoscope, and, failing to find the object, a large tracheotomy tube should be inserted in the hope that coughing may bring out the offending material. This expedient in the case of J. P. might have given a favorable outcome as it did in the case of H. G.

J. P., an infant, was admitted to the surgical service of St. Luke's Hospital, April 18, 1913, with the history of having aspirated a glass bead from a necklace. Before admission two unsuccessful attempts had been made to enter the bronchoscope through the larynx by an outside physician. The cause of the failure was due to the relatively small size of the rima glottidis when compared to the size of the tube used.

When admitted the patient was suffering from pneumonia, and on account of her extreme condition no attempt was made again to pass a bronchoscope. A radiograph was taken, but before more could be done the patient died. No autopsy was allowed.

H. G., aged two and one-half years, was admitted to the surgical service at St. Luke's Hospital, November 14, 1914, with the history of having "swallowed" a fish bone. A radiograph was taken which gave the suspicion of a shadow in the upper part of the trachea, Oesophagoscopy and bronchoscopy failed to reveal a foreign body at this time. The patient was kept under observation for a few days and then, as he showed no further symptoms, was sent home. He was brought back December 3, 1914, suffering with slight dyspnoea, and an intubation was performed by the House Surgeon, Dr. Wells. After a short time another attempt at bronchoscopy was deemed advisable and, on account of the increasing dyspnoea, tracheotomy was prepared for. On attempting to pass the bronchoscope the child ceased breathing. With the assistance of Dr. Steele tracheotomy was rapidly done, and upon opening the trachea the

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patient coughed out through the tube a slender piece of bone three-quarters of an inch long.

After that he made an uninterrupted recovery and was discharged on December 22, 1914, tracheotomy wound healed.

If the attempt to remove the foreign body has been successful in these fresh cases there need be but little fear of further complications, and the patient may be allowed to leave the hospital on the following day, if the peroral route alone has been used.

If the attempt has been unsuccessful and the object has not been coughed out after a tracheotomy, then the case passes on into the next class, that of deferred cases, unless the approach through a posterior bronchotomy be considered advisable and the patient's condition warrants it.

The development of symptoms in this transition stage is awaited with the gravest forebodings, for at this time begin the complications.

These may be pneumonia, gangrene, lung abscess and empyema, in the order named. Either one or all may result in fatality. Or there may be ulceration of the mucosa with perforation and a surrounding cellulitis or abscess formation and sepsis. Or there may be stricture of the bronchus and the development of a bronchiectasis.

In these conditions, should the patient survive the primary acute destruction of tissue, we have remaining a chronic condition with its connective tissue changes, in the centre of which still remains the foreign body.

Patients with these late complications then belong to the deferred class of cases and the foreign body present, which has acted as the exciting cause, still continues to act as an aggravation of the pathological condition until removal.

If the acute complications are survived the final condition of the untreated cases resolves itself into that of a chronic lung abscess containing the foreign body. These chronic lung abscesses resemble bronchiectases, they contain much pus beside the foreign body. Their walls may be irregular or smooth and they always are connected with the outside air by one, or even two, openings.

The patients as far as their symptoms go are suffering from bronchiectasis. They have a profuse intermittent purulent expectoration with greenish, foul-smelling pus. Their cough is worse on lying down. They suffer from afternoon temperature, have a hectic look, but rarely if ever does the sputum contain tubercle bacilli. They have clubbed fingers, especially if the duration of their illness has been over a year.

The treatment of these deferred cases consists of removing the

offending object, and of securing drainage of the purulent accumulation present. This will for a time improve the general condition, but the cavity caused by the foreign body will be very hard to heal. Many of these cases are opened from the outside and a bronchial fistula results. The purulent exudate is mostly discharged through the outside opening and, while doing so, the patient will remain improved. But when the outside opening is closed the patient again will return to nearly as bad a condition as before the removal of the foreign body.

One case of ours, F. B. (Fig. 5), illustrates this well.

Again there may be prompt healing of the outside wound with a great general improvement in the amount and character of the pus coughed up.

In general, the cavity formed by one of these foreign bodies must be treated along the lines of conservative surgery as applied to bronchiectasis.

In a very comprehensive paper by Dr. Willy Meyer on "Bronchiectasis," both the non-operative and operative treatment of this condition are fully discussed. And one cannot do better than to refer to it for a complete history of the current procedure in this class of cases.⁸

Suffice it to say, it requires all the ingenuity one may possess in order to effect an obliteration of one of these lung abscess cavities. In the attempt to treat this condition surgically it is well to proceed by stages, and it is wise not to be too radical with each step. It may even be advisable to allow the patient to enjoy a reasonable degree of comfort rather than subject him to a severe procedure which may jeopardize his life, in the hope of a complete cure.

It is to be noted that in these chronic lung abscesses of long standing the amount of pleuritic adhesions present may be surprisingly and embarrassingly small. One must look to find them far less dense and less extensive than in the recent cases of pleuritic inflammation.

Summing up, the following conclusions may be drawn:

1. All recently aspirated foreign bodies should first be sought by the Röntgen-ray and the bronchoscope, without delay, and removed if possible through the mouth.
2. Failing to remove them through the mouth a tracheotomy should be done and another attempt made by means of the bronchoscope.
3. Failing in this the tracheal wound should be held widely open by wires or a large tube in the hope that the foreign body may be coughed out.
4. If immediate removal by these methods fail, a period generally elapses in which the patient may undergo secondary changes in the lung.

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such as pneumonia, gangrene, abscess and generally an overlying empyema.

5. If the patients recover from these acute infectious processes, they pass into the class of deferred cases with the foreign body still present as an aggravating factor in their chronic lesion.

6. Removal of the foreign body in these deferred cases does not always effect a cure.

7. The lung abscesses must be treated along surgical lines and even then we cannot always hope for a cure, but rather only an amelioration of their affliction.

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TUBERCULOSIS OF THE BREAST*

A REPORT OF 10 CASES

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AND

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IN a previous contribution to the knowledge of tuberculosis of the female breast, one of us (Durante¹) reviewed the bibliography of the subject to January, 1914, and discussed the anatomic forms, histogenesis, symptoms and therapy. This paper appeared contemporaneously with the excellent and extensive contribution upon the same subject by Deaver² and Herman.

Since January, 1914, four other papers by Leriche,³ Pirrung,⁴ Roffo⁵ and Miles⁶ have appeared and described two types of mammary tuberculosis, namely, the "sclerotic" and "inflammatory" types.

A review of the literature reveals the following important points:

1. The period of apparent greatest susceptibility to mammary tuberculosis is between the twentieth and fortieth years of life. The condition has been found only twice in the female breast before puberty and only ten times in the male breast. A total of 180 cases of all types in the male and female have been reported.

2. Many terms, such as "disseminating," "confluent," "miliary," "nodular," "abscess," "sclerotic" and "inflammatory," have been applied to the various aspects of the condition.

Retraction of the nipple has been reported and is, therefore, a sign which might readily be confused with a similar characteristic of mammary cancer.

3. Seventeen cases (Klose⁷) have been reported in association with neoplastic processes. Practically all observers attributed no relation between the two conditions.

4. The localization of the infection in the breast through an abrasion of the skin, although a possibility, has been considered a remote probability.

5. Practically every case presented itself as a secondary localization from a primary focus in some other portion of the body.

* Submitted for publication, February 21, 1916.

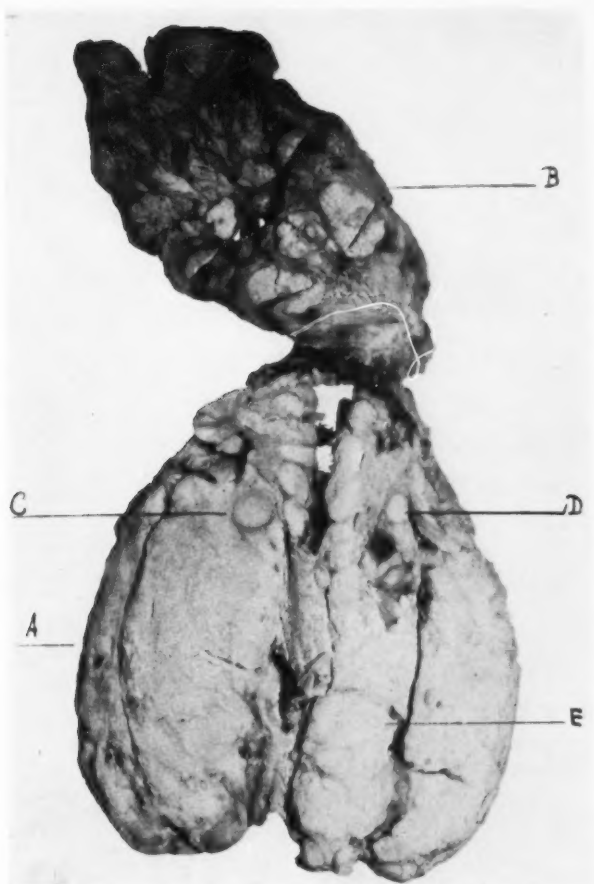


FIG. 1.—(52798) Tuberculosis of the axillary and pectoral lymphatic glands. *A*, breast; *B*, pectoral lymphatic; *C* and *D*, tuberculous glands in the breast.

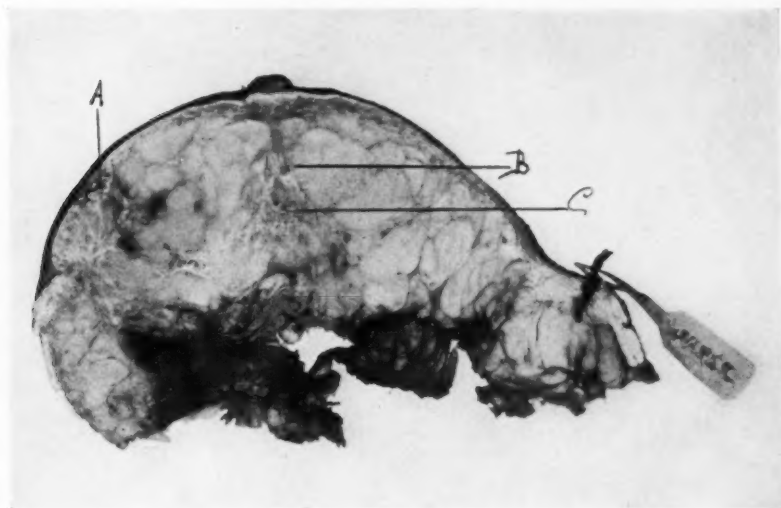


FIG. 2.—(63635) Tuberculosis of the breast, apparently produced by retrograde diffusion from tuberculous axillary adenitis. *A*, *B*, and *C*, tuberculous areas.

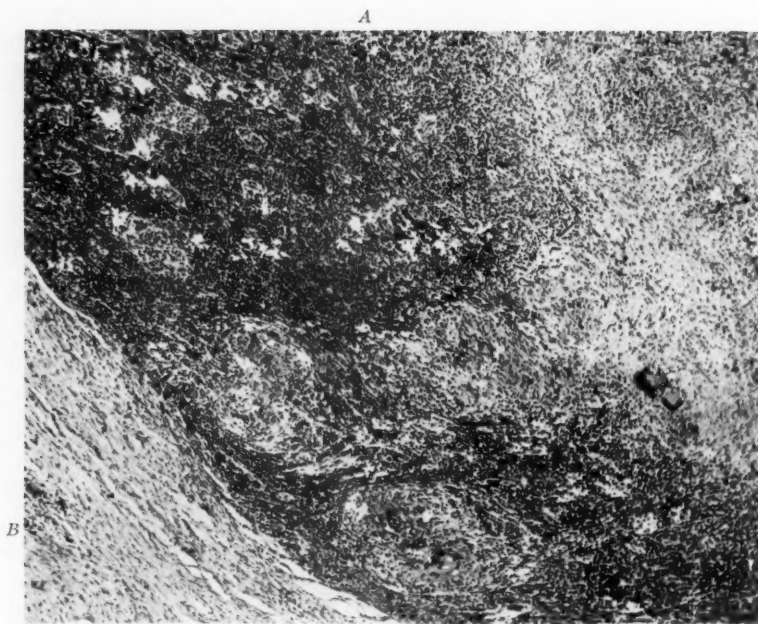


FIG. 3.—(52798) Photomicrograph (x50, Unna-Pappenheim stain). Zone of division, between tuberculous nodule, *A*, and parenchyma of the breast, formed by a barrier of dense connective tissue, *B*. The section was taken from point *D*, Fig. 1.

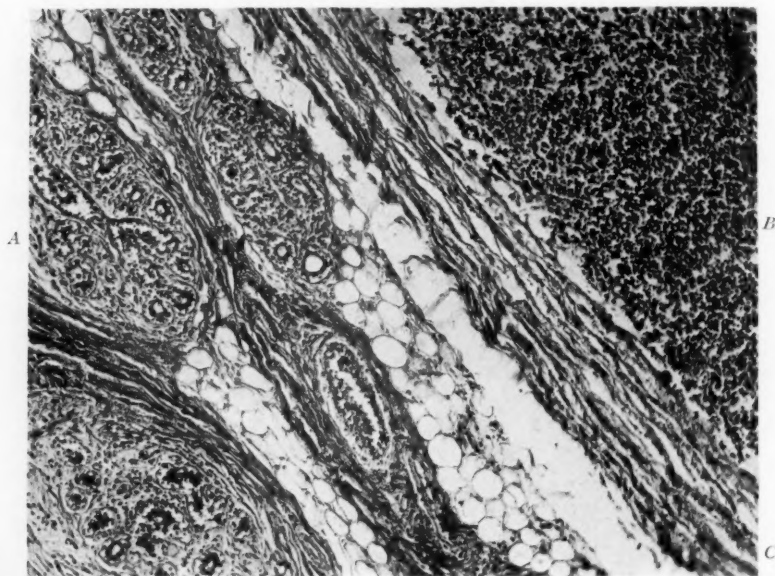


FIG. 4.—(52798) Photomicrograph (x60, Unna-Pappenheim stain) showing zone of division between tuberculous nodule, *B*, and the parenchyma of the breast, *A*. *A*, primary hyperplasia (MacCarty) of mammary acini, surrounded by connective tissue and a slight lymphocytic infiltration; *B*, margin of tuberculous nodule; *C*, barrier of connective tissue, dividing mammary parenchyma from tuberculous nodules. The section was taken from point *C*, Fig. 1.

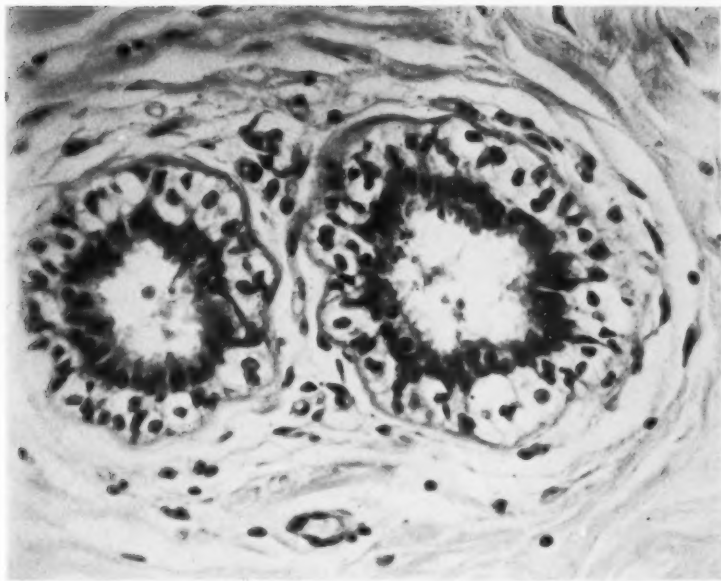


FIG. 5.—(52798) Photomicrograph III (x120, Weighert-Van Gieson stain) showing primary hyperplasia (MacCarty) of mammary acini and connective tissue reaction at point *E*, Fig. 1.

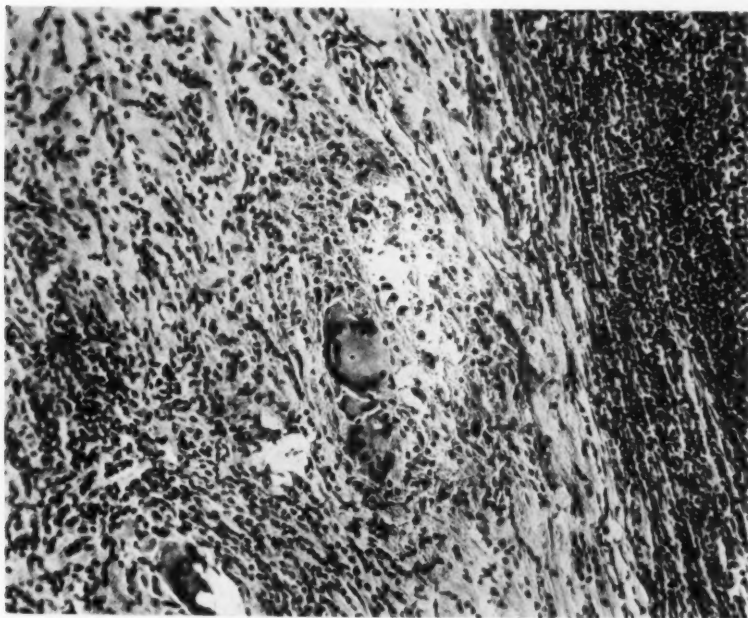


FIG. 6.—Photomicrograph (x120, Unna-Pappenheim stain) showing structures which may be either tuberculous giant-cells or atrophic nuclei.

TUBERCULOSIS OF THE BREAST

6. In the cases which have been reported the most plausible mode of infection was by contiguity with pleural or costal tuberculosis or through blood or lymph streams.

7. All observers considered the blood stream to be the most common route of infection. In some cases, however, no tangible primary focus was discovered.

8. In certain cases the organism was, apparently, carried reversely from the cervical or axillary lymphatic glands which were demonstrably tuberculous. Some cases were attributed to an infection of the retro-sternal lymphatics which follow the collateral branches of the internal mammary artery. Mammary tuberculous infections which were secondary to axillary lymphatic involvement on the same side were described by Duret,⁸ Verneuil,⁹ Berchtold,¹⁰ Salomoni,¹¹ Caminiti,¹² Scott,¹³ Schmidt,¹⁴ Duvergey,¹⁵ Vignard,¹⁶ Pasquier,¹⁶ Putzu,¹⁷ Leriche,⁸ Roffo,⁵ and Durante.¹ Scott,¹³ Bahuand,¹⁸ Braendle,¹⁹ and Cignozzi²⁰ described the condition as secondary to cervical lymphatic involvement.

In the Mayo Clinic from 1904 to 1915 there have been 10 cases (0.51 per cent.) of mammary tuberculosis in a series of 1933 pathologic mammary conditions.

Deaver² found 0.83 per cent., Scott,¹³ 1.4 per cent., and Bloodgood,²¹ 0.6 per cent. of their mammary specimens tuberculous.

In the 10 cases observed by the writers there were three in which no primary focus was clinically demonstrable; there were three associated with tuberculosis of the lungs and three cases associated with no other clinical tuberculous lesion other than tuberculosis of the axillary lymphatic glands, and one which was associated with a pleurocostal lesion.

The gross pathologic picture is one of chronic mastitis characterized by a dirty discoloration of the normally pearly-white glandular tissue, bloody discoloration of fat, cysts, fibrosis, lymphocytic infiltration, localized areas of caseation and giant-cells.

A microscopic diagnosis is essential in practically all cases. This frequently must be aided by the demonstration of the bacillus tuberculosis in smears, cultures, tissues, or by injection into guinea-pigs. The histologic diagnosis is often difficult or impossible because disintegrating atrophic acini, when surrounded by necrosis and fibrosis, sometimes resemble giant-cells. Mistakes are, therefore, not infrequent.

A correct diagnosis from a histologic stand-point can be made only when typical tubercles with caseation, epithelioid cells and giant-cells with peripheral nuclei are present.

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Of. No.	Sex	Age	Tuberculosis heredity	Tuberculous lesions in other organs	General health	Type of lesion	Number of lesions	Side involved	Quadrant of location	Nipple	Skin	Enlargement of axillary glands	Enlargement of cervical glands	Breast pain	Pathology	Koch's bacilli in the histologic sections
1 4522	M	52	-	++ lungs; left empyema	Poor	Abscess	Single	Lt.	Lower	-	Slight inflammation	Rt. -	Lt. -	-	Tuberculosis.	+
2 7475	F	28	-	Lungs	Poor	Nodular	Single	Lt.	Upper exterior	-	-	Rt. -	Lt. -	+	Tuberculosis.	+
3 8102	F	23	+	Lungs	Poor	Abscess	Single	Lt.	Lower exterior	-	Slight inflammation	Rt. -	Lt. -	Slight	Tuberculosis.	+
4 2259	F	27	+	Lungs	Poor	Nodular	Mult.	Lt.	Upper exterior	-	-	Rt. -	Lt. -	Slight	Tuberculosis of breast.	+
5 6353	F	40	-	-	Good	Nodular	Single	Rt.	Upper exterior	Retracted	-	Rt. -	Lt. -	Slight	Tuberculosis of breast.	+
6 9700	F	26	-	Lungs	Poor	Nodular	Mult.	Lt.	Upper exterior	-	-	Rt. -	Lt. -	Slight	Tuberculosis of breast and glands.	+
7 9700	F	26	-	Lungs	Poor	Nodular	Mult.	Rt.	Upper exterior and interior	-	-	Rt. -	Lt. -	Slight	Tuberculosis of breast.	+
8 17117	F	22	-	-	Good	Cyst	Single	Lt.	Nipple region	-	-	Rt. -	Lt. -	Slight	Tuberculous wall of cyst.	+
9 21077	F	41	-	-	Good	Fistula	Single	Lt.	Upper exterior	-	Ulcerated	Rt. -	Lt. -	Slight	Tuberculous mastitis.	+
10 52758	F	28	-	-	Fine	Diffuse sclerosis	Single	Rt.	Generalized	Retracted	-	Rt. -	Lt. -	Slight	Tuberculous mastitis, tuberculous glands.	+
11 63635	F	42	-	Right adnexa and appendix removed elsewhere 2 years before	Poor	Diffuse sclerosis	Single	Rt.	Generalized	-	-	Rt. -	Lt. -	Slight	Tuberculosis of breast and glands.	+

TUBERCULOSIS OF THE BREAST

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A DENTAL PLATE IN THE ŒSOPHAGUS

By GILBERT D. GREGOR, M.D.

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ON November 27, 1915, Dr. S. C. Hollis, of Belleville, N. Y., referred Mr. L. P. to me, who gave the following history: Two days ago while eating his Thanksgiving dinner he experienced a sudden choking sensation and immediately missed a dental plate from his mouth. All efforts to rescue the plate were futile. On Saturday he consulted Dr. Hollis, who sent him to me. There was considerable pain in the throat and tenderness just above the suprasternal notch and inability to swallow anything except liquids in small amounts. As he was compelled to return to his home that night nothing was done until Monday, when he entered the Watertown City Hospital. Tuesday Dr. W. J. Kellow of the Hospital Staff made an X-ray picture, which showed the plate lodged at the second constriction of the œsophagus, the upper edge of the plate being just below the cricoid cartilage and the lower border carrying the teeth just above the suprasternal notch.

This plate had been worn a number of years and was made to carry the four upper incisor teeth. Its lateral border did not overlap the alveolar process on either side, but was made to fit around a few teeth left in the upper jaw, thus making its lateral border irregularly serrated. The subsequent breaking off of these teeth made the position of the plate in the mouth rather insecure and led to the unfortunate accident that spoiled his Thanksgiving dinner.

At this time the patient was in constant discomfort and was unable to swallow liquids of any kind. His voice had become husky and he was troubled with an annoying cough. He could only sleep in a semi-recumbent position and then by the aid of an opiate.

It seemed that it might be possible to remove the plate without a cutting operation, so I asked Dr. J. F. McCaw to examine the patient and the X-ray plates. On Wednesday, December 1, with the patient under full ether anæsthesia, Dr. McCaw made the attempt. The plate was easily exposed by means of the œsophagoscope, but all attempts to dislodge it, without the use of a dangerous degree of force, utterly failed, apparently on account of the serrated edges being buried in the mucous membrane. After over an hour's efforts this method was abandoned and the patient returned to his bed. On the next day he was again anæsthetized by Dr. McCreary and with the assistance of my associate, Dr.



FIG. 1.—Anteroposterior view, showing dental plate impacted in the œsophagus.



A DENTAL PLATE IN THE OESOPHAGUS

Gardner, I did the ordinary external oesophagostomy, going in on the left side, dividing, however, the anterior belly of the omohyoid muscle instead of simply retracting it. A few veins from the thyroid gland to the internal jugular and the inferior thyroid artery were the only vessels of importance encountered. These were all clamped before being cut, so it was practically a dry dissection.

As soon as the middle layer of the deep fascia was divided and the carotid vessels drawn outward and the thyroid gland and trachea drawn mesially, the oesophagus came into view and the plate was plainly felt through its walls. An incision through the postero-lateral wall of the oesophagus directly on to the plate exposed it and it was carefully removed.

Following the advice of writers on the subject a stomach tube was passed into the stomach through the oesophageal opening and the wound closed around it. A small bit of gauze was placed against the oesophagus below the tube and the balance of the wound closed in layers. The patient was fed through the tube for five days, when it was removed and he was allowed a semisolid diet, care being taken to make some compression over the wound during the act of deglutition. The packing was removed on the sixth day and the patient was discharged from the hospital on the twelfth, with the wound practically closed. From the kindness with which the wound healed, I am inclined to think the stomach tube was unnecessary, and in another similar case should close the oesophageal wound at once, simply draining the external part of the wound.

THE APERIOSTEAL STUMP AND ITS CARE*

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AFTER the preservation of the life of the patient, the goal of all amputations is the production of a useful stump. To obtain this three cardinal points must be observed: (1) Correct treatment of the soft parts; (2) correct treatment of the bone; (3) prevention of stump atrophy.

Assuming that the treatment of the soft parts is well standardized, we will confine our remarks to the treatment of the bone and the prevention of stump atrophy.

Modern surgical technic now demands that all amputations of the lower extremity yield stumps capable of directly supporting the whole weight of the body.

In amputations there are four methods of treating the bone: the osteoplastic, tendinoplastic, periosteal and aperiosteal. The osteoplastic is the ideal method, but requires ideal conditions; the tendinoplastic is of limited usefulness; the periosteal, although employed by the majority of the surgeons in this country, is inferior to the other methods and should be abandoned; while the aperiosteal, in the advent of complications in healing, is the only method which is likely to furnish a useful end-bearing stump. It is the simplest, the most universally applicable and the most practicable (Figs. 1 and 2).

The possibility of obtaining an end-bearing stump in a periosteal amputation through the thigh is scouted by the artificial limb makers. The few end-bearing stumps they come in contact with are osteoplastic stumps, or amputations through the epiphysis.

If you examine the standard artificial limbs for thigh amputations you will see that the stump socket is designed to avoid direct pressure on the end of the stump, and to transfer as much weight as possible to the pelvic girdle. That is, in America, we are not living up to the standard set by Bier.

In a paper¹ read before the American Medical Association in 1914, we called attention to the notoriously bad results obtained in amputation

* Read before the New York Surgical Society, February 23, 1916.

¹ Lyle, H. H. M.: Jour. A. M. A., October 3, 1914, lxiii, pp. 1149-1152.

THE APERIOSTEAL STUMP AND ITS CARE

through the shaft of the femur, and strongly advocated the employment of the aperiosteal method where the osteoplastic could not be used.

During the past year it has been our good fortune to have the privilege of examining numerous amputation stumps both here and abroad. As a member of the Technical Committee for furnishing artificial limbs for France we have had the opportunity of examining a large number of amputation stumps from different parts of this country. These demonstrations have been furnished by makers applying for contracts. In forty-seven femur cases we have seen only two true end-bearing stumps. In the majority of these cases we feel that the fault did not lie with the technic of the operator, but with the method of the bone treatment and the after-care of the stump.

The aperiosteal method aims to produce a painless supporting stump capable of early functional use. The essential points of the technic consist in removing a small cuff of periosteum from the bone stump and spooning out the marrow cavity for a like distance, plus the after medicomechanical treatment of the stump.

Technic.—A small cuff of periosteum, 0.5 cm. in depth, is removed and the removal is carried out in such a manner that no shreds of periosteum remain. Such shreds retaining their primitive osteogenetic function are capable of producing painful bony spikes, which would interfere with the early functional use of the stump (contrast Figs. 1 and 2 with 3).

Fig. 4 shows the result of incorrect technic. In this case instead of sawing through the bone the operator raised a cuff of periosteum, sawed through the bone, and then cut away the periosteal cuff. In other words, there was an unnecessary stripping of the periosteum with the resultant formation of numerous osteophytes. In Fig. 1 the bone and periosteum were divided together and the periosteal cuff carefully removed from above downward, the marrow being scraped for a corresponding distance. More than 1 cm. should never be removed on account of the possibility of bone necrosis.

The After-care of the Stump.—The best formed stump if not quickly put to use as a real support may become atrophied and useless (Figs. 5 and 6). It is this special feature of the aperiosteal method that we wish to emphasize. The patient is put to bed with the leg elevated. As soon as the wound is healed begin Hirsch's medicomechanical treatment. Massage the stump twice daily, and after each treatment rub in a 2 per cent. solution of salicylic acid in olive oil. At night bathe in a warm sodium carbonate solution. Protect the stump with lamb's wool. Place a box at the foot of the bed and have the

patient press the stump against it for from five to ten minutes three times a day; then four times; finally every hour. After each treatment energetically flex and extend the hip and knee. Now begin standing exercises. Rest the stump on a bran-bag or a cane-seated chair, at first placing the weight evenly on both legs; later place all the weight on the stump. At the end of two weeks the patient should be able to

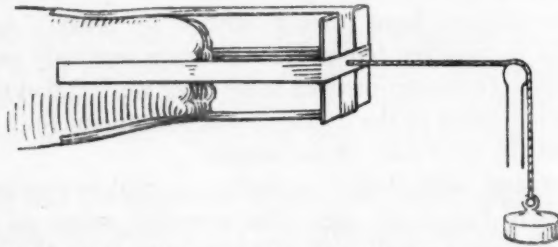


FIG. 7.—Extension applied to the soft parts to prevent retraction. Applicable in cases which have become infected or which have been treated by the open method.

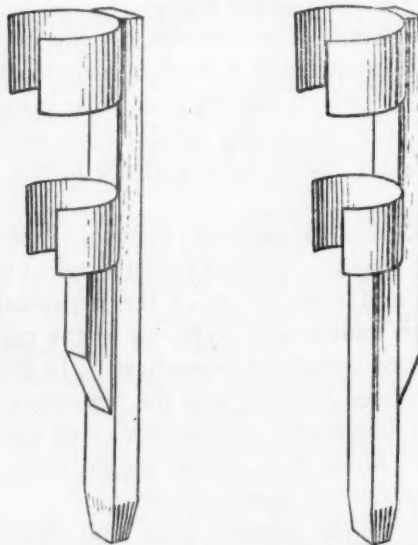


FIG. 16.—Hirsch's provisional peg-legs.

wear a peg leg, later a permanent prosthetic appliance which directly receives the weight through the end of the stump (Figs. 7-16).

If a surgeon decides to perform an aperiosteal or any other type of amputation he has no moral right to undertake it if he is not willing to carry out an after-treatment which aims to provide a painless end-bearing stump. To allow a maimed man to go through life with an

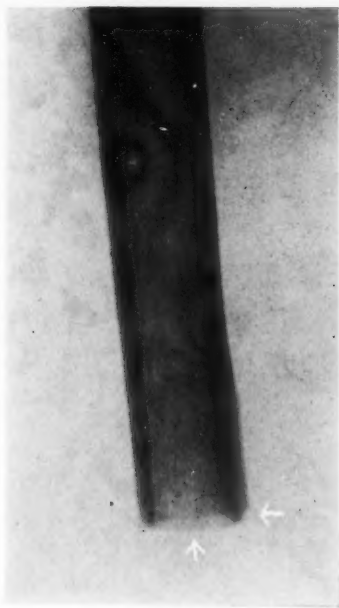


FIG. 1.—Result of an aperiosteal amputation of the thigh in a man sixty-four years old. Note smooth stump end and absence of bone atrophy. Patient was able to bear his whole weight on the end of the stump within fourteen days and walked on a provisional peg-leg within eighteen days.



FIG. 2.—Result of aperiosteal amputation. Note the smooth stump and the absence of bone atrophy.

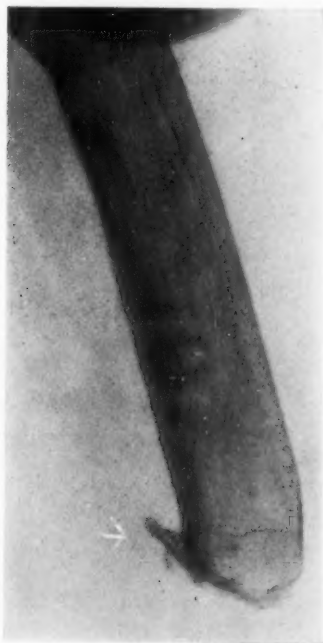


FIG. 3.—Painful stump, due to bony spicules resulting from periosteal amputation of the thigh.



FIG. 4.—Result of aperiosteal amputation incorrectly performed. Note spicules of bone. These were smoothed off by early functional use.



FIG. 5.—A painful conical stump, the result of periosteal amputation of the thigh. The patient was unable to bear any weight on the stump.



FIG. 6.—Painful atrophic stump one year after periosteal amputation of the thigh. Shows baneful results of disuse, stump shrinkers, etc.



FIG. 8.—Construction of a temporary end-bearing peg-leg: Skeleton framework for a temporary end-bearing peg-leg. The plaster bucket for the stump is constructed around the framework. This framework consists of a circular disc of wood the size of the stump (the common fault is to make this too wide). The central peg is formed from a rake handle. Strips of wire mesh are secured to the wooden disc and peg by staples. The longer strips are placed externally.



FIG. 9.—Construction of a temporary end-bearing peg-leg: A seamless sock is drawn over the stump and a few turns of plaster applied in such a manner that the stump end is left open.



FIG. 10.—Construction of a temporary end-bearing peg-leg: The framework of the peg-leg has been applied over the plaster and fixed in place by interweaving the turns of the bandage between the strips of wire netting. This insures a firm union of the plaster and netting, reduces weight and strengthens the plaster bucket. Note that the plaster extends from the bucket over the disc to the peg; this braces the union between the disc and the peg. The weight of the stump rests against a felt pad and a layer of lamb's wool. The lamb's wool to be renewed when necessary. The walking end of the peg is furnished with a rubber tip.



FIG. 11.—Construction of a temporary end-bearing peg-leg: Posterior view, showing the arrangement of the supporting straps. These straps are incorporated into the plaster on the interweaving principle.



FIG. 12.—Aperiosteal amputation. Patient bearing his weight on the stump, fourteen days after the healing of the wound. (Amputation performed by F. Mathews.)

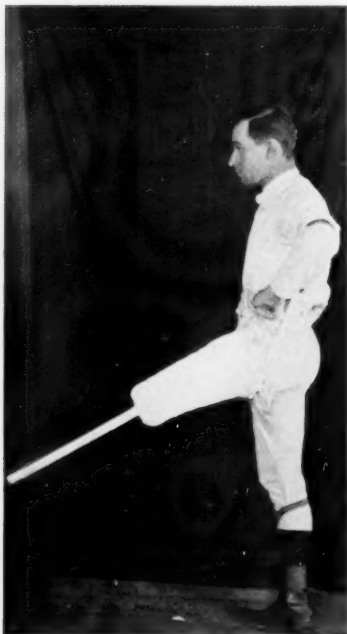


FIG. 13.—Aperiosteal amputation. Patient exercising with peg-leg.



FIG. 14.—Aperiosteal amputation. Patient exercising with peg-leg.



FIG. 15.—Aperiosteal amputation. Patient wearing a home-made peg-leg. Patient was able to walk on this leg fourteen days after the healing of the wound.

THE APERIOSTEAL STUMP AND ITS CARE

ever-present painful stump is a heavy responsibility. Except you have come in contact with a large number of these sufferers you can scarcely realize what the problem means. One thing I am sure of; they have a very poor opinion of surgeons and surgery. We must ask ourselves if this estimate is just. Considered in the light of past standards it is not; considered in the light of the higher standard set by Bier it is.

An early functional use of the stump is the best method of preventing atrophy. This is in direct opposition to the accepted teachings of this country. The majority of patients are turned over to the artificial limb maker, who institutes a course of stump shrinking, which lasts from three to six months until a permanent atrophy of the stump is obtained. The atrophied stump is then considered ready for a permanent prosthetic appliance. Unfortunately, these appliances are designed to aid and abet the vicious atrophy-producing theory. The whole treatment is an attempt to make a part strong by using every known physiological and mechanical means to make it weaker.

CONCLUSIONS

1. No stump should be considered good unless it is capable of supporting the whole weight of the body.
2. Judged by this standard the average American stump is a failure.
3. The number of poor results obtained by competent operators shows that the periosteal method rather than the operator is at fault.
4. As soon as the wound is healed, institute the physiological treatment of the stump with the object of developing its weight-bearing powers. Avoid all procedures which cause atrophy.
5. The best formed stump if not quickly put to use as a real support may become atrophied and useless. Within two or three weeks of the healing of the wound begin walking on a provisional peg-leg. Such peg-leg to be applied so that the stump takes all the weight on the end.
6. Insist that the permanent artificial leg be built on the end-bearing principle.

A METHOD OF FACILITATING INFILTRATION ANÆSTHESIA

BY WILLARD BARTLETT, M.D.

OF ST. LOUIS

BRAUN issues the dictum that an all metal hand-syringe is the proper instrument for administering local infiltration anæsthesia, but there is a loss of the operator's time and energy in the effort of refilling, if one syringe is used, and the same prodigality in changing and reintroducing, if more than one is employed.

The patient is conscious of a prolonged ordeal because of the ordinary refilling and changing of syringes, and there is unavoidable knowledge and strain incident to the many needle reintroductions, due to refilling through one needle.

The simple apparatus required, as seen in the cut, can readily be assembled in any hospital on short notice. It consists of a supply tank holding about 500-1000 c.c., with gravity flow, a rubber hose about one metre long, and an ordinary two-way cock which can be obtained with metal syringes of convenient sizes—my own preference is for one of 10 c.c. capacity. A one-half per cent. solution of novocaine, with 1 c.c. of adrenalin 1-1000 added for every 200 c.c. of novocaine, is used in almost any quantity desired without fear of toxic symptoms, after the well-known technic of Braun.¹

A field of about 18 cm. in diameter, large enough for most purposes, can be infiltrated through a single puncture using about a 9 cm. needle.

Make the ordinary intradermal bleb with a tiny hypodermic needle, then introduce the large needle painlessly through it, continuing, with the needle in place, to empty and fill the syringe as rapidly as the piston can be forced in and out while an assistant shifts the stop-cock in the direction indicated. The apparatus carries out the simple mechanical principle underlying the single-acting force pump.

Air should be carefully expelled as usual, before the first introduction of the needle. There is no possibility of its subsequent introduction, provided the stop-cock be switched to intake just before each piston down-stroke is completed.

The above obtains, of course, only for syringes with needles firmly attached. Those with slip joints are not suitable, to the writer's mind, on account of the frequency with which they "blow off."

Braun² used an apparatus like this one for injecting larger amounts

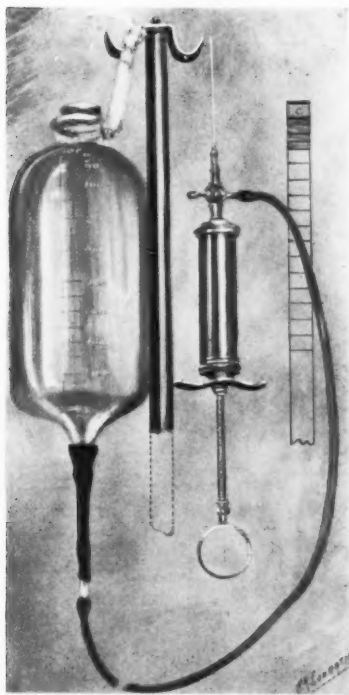
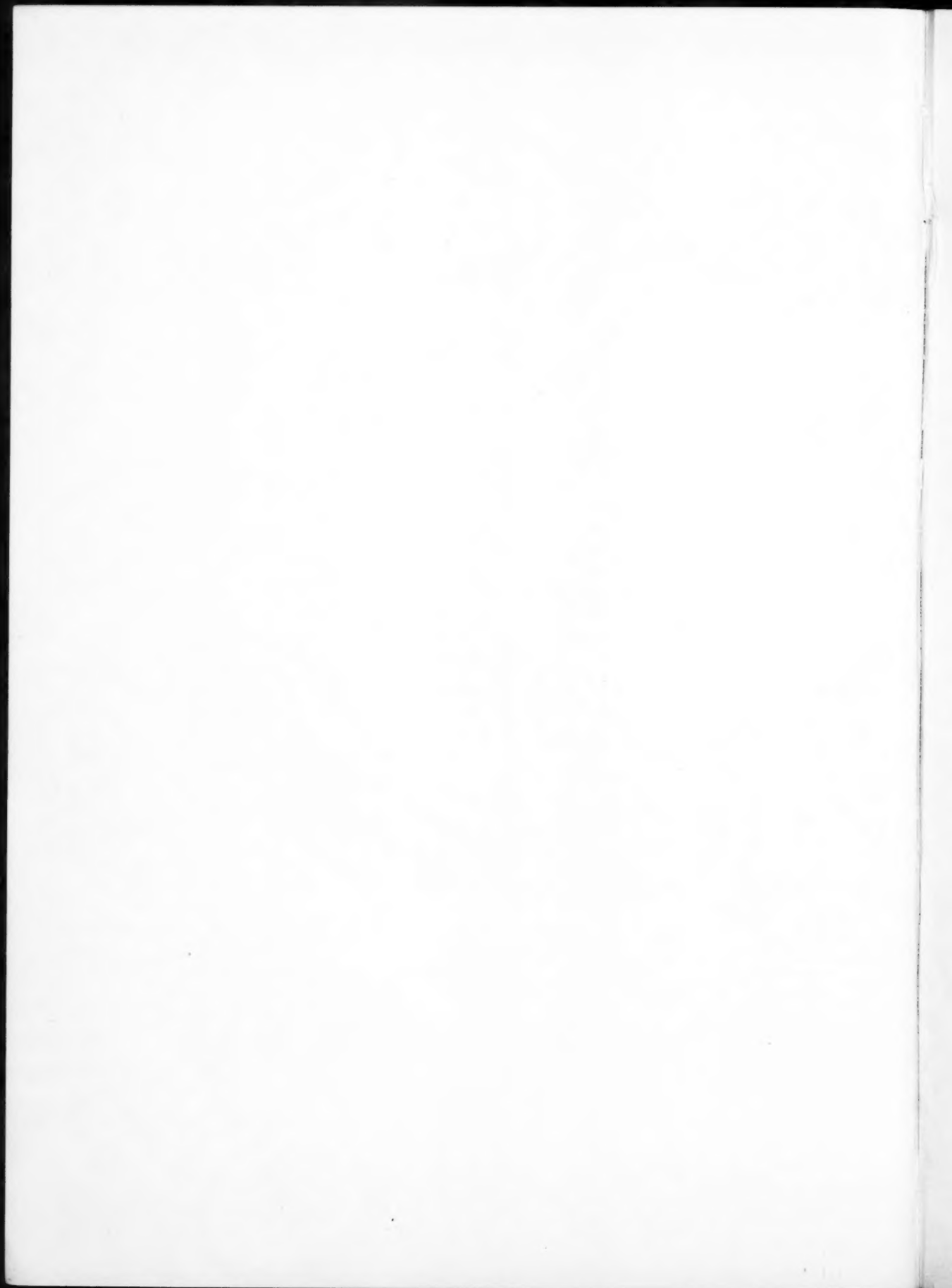


FIG. 1.—Showing container, syringe with two-way cock and infiltrating needle; also centimetre measure.



FACILITATING INFILTRATION ANÆSTHESIA

of fluid, but he makes no mention of it in his last (third) edition. This article is written in the hope that a valuable method will not disappear because the chief exponent of local anæsthesia has ceased to favor and advise its use.

The plan was original as far as the writer is concerned and had been used by him with the greatest satisfaction long before he discovered that it had been employed and discarded by Braun. Naturally, Braun gets any credit for priority and it is to be hoped that he will replace it in a future edition of his valuable work.

Zawodski and Strauss² used an apparatus similar to the one pictured, but having an automatic valve which is stated by Braun to have proven unreliable and troublesome.

Matas³ improvised an injecting outfit by utilizing a Potain aspirator with the valves reversed. An ordinary bottle is used to hold the anæsthetic solution and the stopper with stop-cock connections is held in position by a clamp provided with thumb screws to prevent the pressure forcing out the stopper. He also advises against slip-fitting connections. The pumping apparatus forces air into the bottle instead of creating a vacuum; this is then detached and the outlet tube with the needle is attached. The bottle is inverted and held in position by an assistant.

Allen,⁴ in his book on "Local and Regional Anæsthesia," illustrated a Matas apparatus which employs the above principle in a perfected and simpler form.

Stille and Moskovicz² devised machines which worked on the principle of that used by Matas.

Hammer⁵ made an all-metal syringe into which the solution is poured from an opening in the side in front of the extended piston. The objection made to it is that the needle is fixed to the syringe and must be withdrawn to fill.

The Shield⁵ syringe is a modified Hammer, which has a slip-joint needle attachment, and a collar about the side opening to facilitate filling.

Spiegel² employed a syringe which filled automatically by means of a coiled spring in front of the piston.

Kuhn⁶ uses what resembles a tire pump to produce air pressure 2-4 times that of the atmosphere, within a 200-300 gm. flask, containing novocaine and adrenalin and in this way produces a constant stream through the needle, the same being interrupted at will by a sort of trigger arrangement.

The consensus of surgical opinion is in favor of introducing fluid

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by direct finger pressure on a piston, that giving the best possible control; since a syringe is to be used, one inclines naturally toward a "filling" method which insures the maximum of satisfaction for both patient and surgeon.

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CALCAREOUS DEGENERATION OF THE PROSTATE GLAND*

REPORT OF A CASE

By G. SHEARMAN PETERKIN, M.D.

OF SEATTLE, WASHINGTON

PATIENT S429; male, aged fifty-nine. In August, 1900, fell on saddle horn; urethral hemorrhage; no retention, not even difficulty in urination. In January, 1901, five months later, confined to bed with bladder trouble. At this time claimed abscess broke, as there was a copious discharge of thin pus from meatus, after which symptoms of cystitis were relieved, but recovery not complete. Prostatic distress and cystitis continued, but not severe enough to incapacitate. The following two years at intervals injected into bladder with a small piston syringe various medications, also catheterized self, using no sterilization for hand or catheter; lubricant, vaseline or saliva. During this period had no surgical treatment or other instrumentation.

In 1910 second accident; fell from bicycle and injured perineum. Suffered constant severe pain for four days; pain relieved by discharge of pus from meatus. On subsidence of acute symptoms, pain, tenesmus, etc., received prostatic massage and continued same for three months. During the following three years, 1910 to 1913, frequency of urination continued and semi-incontinency existed, to extent that patient passed unconsciously at intervals a small amount of purulent and fetid urine both day and night. Bladder capacity two or three ounces, judging from the amount of urine voided.

In 1913, first noticed a hardness and a constant enlargement in the prostatic area. Treatment received, general hydrotherapy and prostatic massage, without relief, but rather with an increase of symptoms. In 1914, lady osteopath massaged prostate for what she called "hard tumor."

Up to the time of consultation, continued to have prostatic distress and frequency of urination, with passage of very fetid and purulent urine, accompanied by considerable bleeding. No history of retention of urine.

Patient first seen October 11, 1915.

Subjective Symptoms.—Frequency of urination, every one or two hours during the day, less often at night. Burning pain during whole act, tenesmus at end of act; constant dull aching pain in perineum and in bladder above symphysis; occasionally in back.

* Read before the Swedish Hospital Clinical Society of Seattle, December 7, 1915.

Each act of urination was accompanied by considerable amount of bright blood, bleeding more pronounced at end of act. General appearance, anæmic, pasty and debilitated. Loss of weight, fifteen pounds. Appetite poor, bowels very constipated.

Clinical History.—Heart, irregular and weak, no pathologic condition present. Pulse, 64; temperature, 97. Radial and temporal arteries sclerotic. Catheterization of bladder, one-half ounce residual urine; considerable resistance to catheter as though stone present. Palpation per rectum gave tactile impression of a mass so round in outline, so smooth in contour as to give one an instant mental picture of a medium-sized Japanese orange, but an orange that was ossified, judging from its uniform stony hardness. Prostate not tender on pressure. Capacity of bladder, four ounces.

Cystoscopy.—Showed a subacute general cystitis, bladder wall trabecular, bladder filled with purulent urine, and trabecular cavities with inspissated pus; so extensive and tenacious was the pus that the cystoscopic medium could not be rendered clear enough for a thorough examination. When sufficient irrigating force and distention was employed to free mucopus from bladder wall and trabecular cavities, marked bleeding occurred. Ureters not catheterized; cause, cloudy character of medium and inability to move the cystoscope within range of either ureter due to contracted and inelastic prostatic urethra. Upon withdrawing cystoscope, prostatic urethra showed phosphatic mass, covered with mucus, and outline indistinguishable due to bleeding.

Laboratory Findings.—Complement fixation test for syphilis and gonorrhœa negative.

Urine turbid, the odor extremely offensive—not decomposed, but fecal; reaction acid; specific gravity, 1.025; albumin; no sugar; traces of indican; much pus; many red blood-cells; no casts. Microorganisms: Many bacilli, cocci, and numerous spirochætæ. These latter organisms, judging from the odor, belonged to the species of spirochætæ named by Noguchi "Treponema microdentium." Blood count, red, 4,300,000; white, 11,000. Blood-pressure, diastolic, 100; systolic, 150.

October 12, X-ray of bladder distended with boracic acid gave radiographic picture as shown in Fig. 1. October 14, bladder filled with normal salt solution gave radiographic picture as shown in Fig. 2; filled with air, Fig. 3; filled with silver iodide, Fig. 4.

Examination of these plates permits drawing the following conclusions:

1. That the X-ray is an essential as a means of obtaining direct and corroborative evidence of pathologic conditions of the bladder.



FIG. 1.—Radiograph showing concretions in bladder.

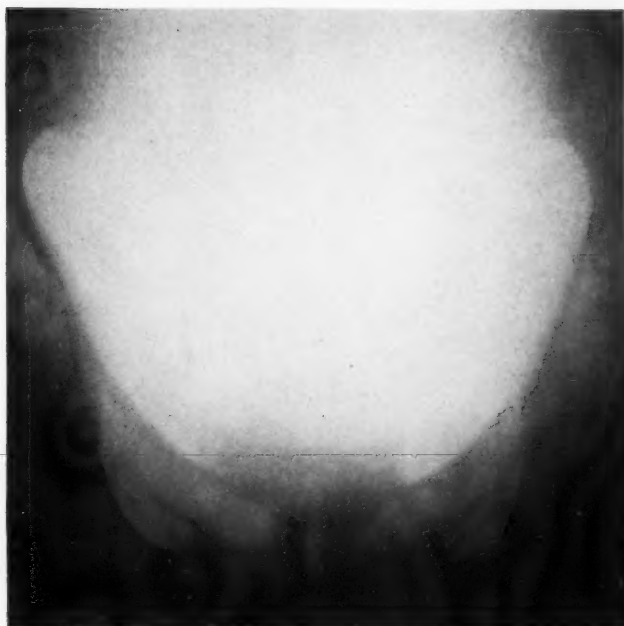


FIG. 2.—Radiograph of bladder filled with normal salt solution.



FIG. 3.—Radiograph of bladder filled with air.



FIG. 4.—Radiograph of bladder filled with silver iodide solution.

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In this case, the X-ray gives direct evidence, the cystoscope negative evidence.

2. Fig. 1 emphasizes an old adage: Thorough cleansing of the bowels obviates mistakes. The bowels not cleansed, present shadows as here shown.

3. Figs. 2, 3 and 4 illustrate the relative value of urine or aseptic fluids, air or oxygen, silver iodide or other solutions of like nature, as mediums for X-ray work. Comparing the shadows of the bladder in Fig. 2, filled with normal salt solution, and Fig. 3, filled with air, illustrates that air and oxygen as a medium will show concretions of low specific gravity, which may not be seen when the medium employed is urine or antiseptic solution.

4. Fig. 4 shows that silver iodide should be employed to outline the bladder; air and oxygen to ascertain the presence of foreign bodies. This plate, an exceptional and rather unique radiograph, shows distinctly the outline of an enlarged prostate and a tra-

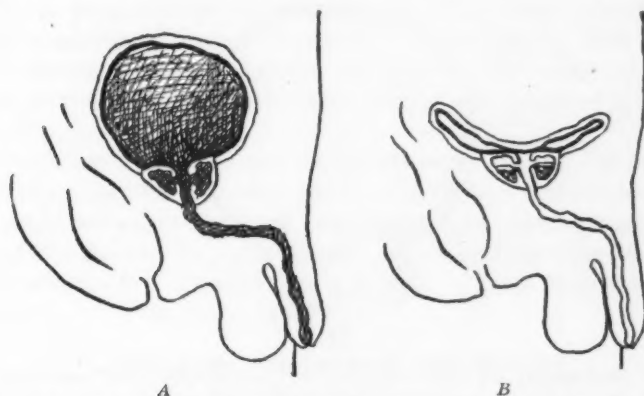


FIG. 5.—Drawing showing formation of prostatic stone. A, bladder filled; B, bladder empty; residue in prostate.

becular bladder above it. It contains also a diagnostic point of infinite value. This is the white shadow extending between lines *b* and *c*. This line is the compressor urethræ, and the fact that no shadow is cast shows that this muscle is functioning normally and that it has squeezed the silver iodide from between its anterior and posterior margins; whereas the line *a* shows that the mouth of the bladder is destroyed, which demonstrates in this peculiar case the necessity of operating suprapubically and not perineally, for a perineal incision would undoubtedly cause incontinency, even if incision did not involve the triangular ligament.

The diagrammatic drawing (Fig. 5) illustrates the mechanism whereby infection, combined with urinary deposits, gradually and

completely replaced a normal prostate and substituted one of stony formation.

October 22: Under spinal anaesthesia, cystotomy was performed and this semistony mass (Fig. 6), which completely filled the whole prostatic capsule, was removed piecemeal, virtually without bleeding. So completely did this mass fill the prostatic capsule that passing through its centre was a distinct canal through which the urine escaped. This calcareous prostate weighed 31 grammes and was composed almost entirely of calcium carbonate, with a small amount of magnesium and calcium phosphate. A large Freyer's suprapubic drainage tube, diameter $\frac{3}{4}$ inch, was inserted.

Difficulties encountered:

(1) The employment of sufficient force to break up the adamantine prostate, yet not cause the resulting jagged edges to pierce the thin prostatic capsule and produce a recto-prostatic fistula.

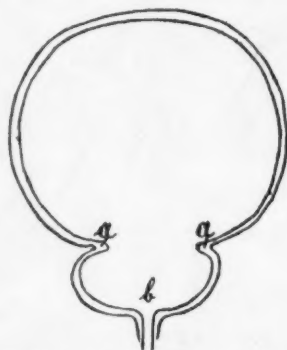


FIG. 7.—Bladder and prostatic cavity after operation.

(2) As soon as any portion of the stony mass was grasped by the forceps, it would partially crumble, and even though the greatest care was exercised, some particles and granules of this tenacious stony material, which had a pronounced sickening fecal odor, were distributed over the wound and held tenaciously to the prevesical fat, fascia, etc. Attempts to remove all such particles and thus prevent infection from same were made with gauze and small forceps.

At the end of the operation, a large uncollapsed (Fig. 7, *b*) prostatic cavity, with a circumference of a medium-sized Japanese orange, existed, and in place of the vesical sphincter there was an indurated ridge (Fig. 7, *a*) about one inch in diameter, that connected the prostatic and bladder cavities.

The following day patient's temperature rose to 99.4° , pulse 80. On October 24, temperature reached 100° – 101° , and from then

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on varied from 100° to 101°, with a pulse from 80 to 96, until November 1, during which time the patient's condition was not of the best.

Due to the unremovable particles of the infecting granules left at the time of the operation, a very pronounced sloughing of the wounded area occurred and all of the stitches in the wound had to be removed. Patient complained of more or less constant pain in upper abdomen, over transverse colon, and general fatigue; also of inability to sleep, even if free from pain. Leucocyte count on October 27, 15,000; polynuclear, 87 per cent.; small leucocytes, 8 per cent.; enlarged leucocytes 2 per cent. Catheter inserted on October 25 in urethra to drain bladder; removed on October 27.

After-treatment consisted of irrigating the suprapubic wound, also bladder through this wound, and the urethra. Boracic acid and, later, 1:6000 permanganate solutions were employed, every four hours at a temperature of 110° F. in percolator.

At no period after operation could patient take nourishment in any quantity; nausea and pronounced constipation, with gastric and intestinal flatulence present, did not respond to varied forms of treatment. General appearance that of low grade of infection with dissolution.

On October 31, pulse was 100, temperature 99.4°. On November 1, ten days after operation, at twelve o'clock, without warning, a pronounced secondary hemorrhage occurred, which necessitated taking the patient to the operating room and packing prostatic cavity with gauze. Patient died November 2, from general debility and anæmia. Autopsy refused.

A case carefully studied often enables one to formulate a definite opinion as to the method of action in a similar case, yet in my mind one question of after-treatment remains unanswered.

This is the advisability of irrigation—was it or was it not a causative factor in the secondary hemorrhage? Here (Fig. 7) there are two cavities, the bladder and the prostatic cavity. The walls of the latter, though infiltrated, were thin and uncollapsible, and still clinging to it tenaciously were many small particles of this infectious crustation. The opening between this prostatic cavity and the bladder was patent. This prostatic cavity open, as it was, formed a dumping ground for infection and urinary deposits which would ultimately result, were it not cleansed, in the same pathologic condition as previously existed. On this theory, an attempt was made to keep it clean by irrigation, as stated. Was this method of procedure advisable? The question still remains unanswered.

THE TECHNIC OF SUPRAPUBIC CYSTOSTOMY IN BADLY INFECTED CASES

BY HADLEY WILLIAMS, F.R.C.S. (ENG.)

OF LONDON, CANADA

THE following procedure has been adopted during the last twelve months for suprapubic cystostomy, where a delay of a few days or a week is permissible, and in those cases where the bladder is badly infected, in order to aid by every possible means the recovery of a patient who is often old and decrepit with arteriosclerosis, thickened bladder and perhaps grave renal insufficiency.

Every surgeon knows how readily a normal bladder will unite when infection is absent or at a minimum, and the wall, itself, has been treated in a gentle and clean-cut manner. Until recently, the operation was performed at one sitting, whether for the removal of a foreign body or enucleation of the prostate; but this has been largely given up for the so-called "two-stage" operation, with much better results. This procedure goes a step farther in the class of case just mentioned, in order to insure the patient against the risk of septic infiltration of the paravesical connective tissue with its often serious consequences.

Cystotomy was first introduced by Franco in 1556, but only exceptionally performed in the earlier days on account of the great danger of infection, not only to the bladder, ureter and kidney, but also to the tissues of the abdominal wall and the fatty connective tissue in the space of Retzius. The mortality rate, in fact, was very high.

Aseptic treatment of wounds has worked marvels here as in all other fields, but has not wiped out the dangers of this operation. M. Guyon had a patient die with purulent infiltration of the subperitoneal connective tissue, and Jacobson lost a case with cellulitis on the fourth day. Cadge (in Treves's *Operative Surgery*) gives the rate of mortality in patients over fifty, after a suprapubic cystotomy for stone, as 27 per cent. The actual causes are not discussed. At any rate, all surgeons meet with sloughy conditions of the wound, induration, purulent infiltration and dangerous absorption in these cases and, aside from continual irrigation of the bladder and the use of the siphon, many have advised varied technic to remedy the trouble.

These patients are nearly all old with some sclerosed condition of the arteries, a liability to thrombosis, pneumonia and the like and with renal insufficiency, dependent more or less on the length and character

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of the obstruction. For instance, Poucet and Delorine think that by "suturing the edges of the bladder to the skin, infiltration of the tissues with infected urine is most effectually prevented." Kocher says, "It is better to insert a large tube for drainage down to the bottom of the bladder and pack external wound all around with antiseptic gauze, or stitch a tube into the bladder in a water-tight manner and siphon off the contents." Jacobson suggests "suturing the cut edges of the bladder and fascia and deeper edges of the wound to save the patient the great risks of extravasation."

It must be confessed that all these methods are incomplete, as, since the bladder is opened immediately, the infiltration of septic urine will be sure to occur to some extent around the sutured edges and the tube, no matter how thoroughly the technic has been carried out, to say nothing of the difficulty in bringing the skin edges and the bladder together, in very stout patients, and the injury from tension and suturing to its wall.

Freyer says in discussing prostatectomy, "The tube is left *in situ* for four days or more, for by this time plastic lymph will have been thrown out around the tube, thus shutting off the paravesical space from contact with the urine and avoiding cellulitis."

Note here that nothing is done to avoid this condition prior to the removal of the tube. It also seems that the less the bruising and the cleaner the cut into the tissues involved in cystostomy (other things being equal) the more rapid will be the resulting recovery and with less danger of septic absorption and the train of symptoms that follow. The danger of infection, indeed, would not be lessened by attempting to close off the urine by these methods, by burrowing into the paravesical spaces, but would be increased by tending to prevent sufficient exit if infection did take place; so that packing with gauze not only around the tube, above the region of the attachment of the peritoneum, and forward in the space of Retzius is much more scientific and effectual for the end in view. Indeed, when the tube is left in the bladder, most surgeons take the precaution to leave a strip of gauze for postpubic drainage in all their cases, which at least has the merit of attempted drainage away from the depth of the wound to the surface. At any rate, the thrombosed character of some of these wounds, and sloughing of the tissues with added danger to the patient already in a condition unable often to resist the least infection, to say nothing of the bed of the prostate when this is removed, necessitates some method whereby the wound can be sealed off before the escape of the infected urine. The method discussed here is applicable to the evacuation of pus from all cavities where delay is

possible and is in harmony with nature's own method in this direction.

Formerly surgeons went boldly down to the bladder and opened the cavity immediately. If tearing and bruising occurred, septic infiltration of the tissues sometimes occurred with unfortunate results.

The procedure adopted, then, to seal the wound is here briefly outlined and is quite simple.

A general anaesthetic with its evident dangers in this class of case is quite unnecessary. Some form of cocaine is used. The vertical incision is adopted rather than a transverse, so as to keep the superficial and deep parts of the wound parallel and present a solid wall on either side when completed, rather than an elongated skin wound stretching at right angles. The muscles are separated in the usual manner and the fatty tissues, with often large veins, carefully incised but not torn or roughly handled, since hemorrhage often occurs and may be difficult to control. M. Guyon met with severe hemorrhage in his second case.

Treves lays great stress on this point when he says that, "Prevesical fat should never be torn through; all such rough manipulations open the way for urinary infiltration."

In order to insure safety of the peritoneum, a catheter with an ordinary bulb is previously passed through the urethra and the bladder cautiously, and with extreme care, gently inflated. A warm boric solution is sometimes used instead of inflation and by some is considered safer. This brings the bladder wall into view and pushes the peritoneum out of danger. The fat is carefully reflected sideways and upward and the muscle fibres of the viscus are now easily recognized.

Gussenbauer, Sonnenburg and Kramer mention cases in which the peritoneum was adherent to the pubis. If this condition be found, it matters little, since it can be dissected away, displaced upward and, if necessary, sutured. The five or six days that elapse before the bladder is to be opened ensure the safety of the abdominal cavity. The bladder is now cleaned to the required diameter, according to the object to be removed. If for simple drainage, the space may be small. A guy suture of thread or silk is placed through the muscular coat on either side, fairly close to the medium line, and left *in situ*, the ends being brought up through the wound for future use. A strip of sterile gauze about 3 cm. wide is packed into the depth of the wound and into the postpubic space and on either side, gradually and completely filling the cavity and forming a space perhaps 3 cm. or more in diameter. No sutures are inserted. An ordinary dressing is placed over the wound. The operation only takes a few minutes without the least shock or inconvenience to the patient.

TECHNIC OF SUPRAPUBIC CYSTOSTOMY

At the end of the fourth day at the earliest, but one week usually, the second stage is undertaken. The packing is carefully removed and the wound found to be completely sealed in all directions. The bladder wall is easily recognized and the guy sutures point out the line of incision which, under a few drops of cocaine, is made in a vertical direction to the required length. Great care is taken not to clamp or bruise the bladder wall in any way. The finger is carefully inserted, a tube, if used, placed in position, the decomposing urine immediately pouring through the opening, but the granulations which have sealed the wound prevent any contamination of the paravesical cellular tissue. During the after-treatment the skin remains normal in color without the least sign of induration. There is no pain around the edges of the opening and the general appearance of the wound all that can be desired. In fact, other conditions being equal, a rapid normal healing takes place, with delayed union and primary fistula brought to a minimum. The comfort of these patients is in marked contrast to the discomfort experienced after the immediate cystostomy previously performed, which often left a dusky infiltration of the skin, sloughing tissues, and all the dangers of thrombosis and sepsis with continual care and attention of the nurse and with pain and misery to the patient. For suprapubic prostatectomy, in the worse forms of infected bladder, the "three-stage" operation is now always performed. For vesical calculus this method is ideal. Since there is practically no infection and no shock except that incident to opening the bladder itself, all cases of stone are now treated in this manner with the exception of those patients whose urine is in the best possible condition, and then immediate suture is adopted.

SHIRRING THE ROUND LIGAMENTS*

A NEW METHOD OF SHORTENING THE LIGAMENTS FOR RETRODISPLACEMENTS OF THE UTERUS

By JOHN WESLEY LONG, M.D.

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OPERATIONS upon the round ligaments for the purpose of overcoming backward displacements of the fundus have developed much ingenuity and a great variety of methods. A multitude of men have contributed to this phase of pelvic surgery. The bare mention of a method, whether new or old, rarely fails to evoke an interminable discussion.

To this arraignment I plead guilty to the extent of having invented one operation for shortening the round ligaments some nine years ago and now come forward with a second.

Before the North Carolina Medical Society in 1907,¹ I read a paper with the title, "Preperitoneal Shortening of the Round Ligaments." The occasion and paper were rendered memorable by a rather spirited but good-natured discussion of the subject by that master of gynec surgery, Dr. Howard A. Kelly, and myself.

At the Atlanta meeting of this Association, in 1913,² I gave a brief description of the operation which I purpose describing more fully at this time.

The operation I have christened "shirring the round ligaments," since the designation describes to a nicety the procedure employed, as we shall see. The method is applicable only in those cases in which it is expedient to open the abdomen. For simplicity, ease of execution and efficiency, it surpasses any operation for the purpose I ever tried or saw published.

I shall make no attempt to discuss the indications for shortening the round ligaments, or to enter into the relative merits of the many types of operation employed for this purpose. I leave those questions for a subsequent occasion.

The illustrations make plain the succeeding stages and immediate results of the operation.

The first step, after having opened the abdomen and exposed the parts, is to seize the round ligament about midway with forceps (Fig. 1).

* Read before the Southern Surg. and Gynec. Assn., December 15, 1915.

¹ Transactions, North Car. Med. Society, 1907, p. 168.

² Transactions, Southern Surg. and Gynec. Assn., 1913, p. 85.

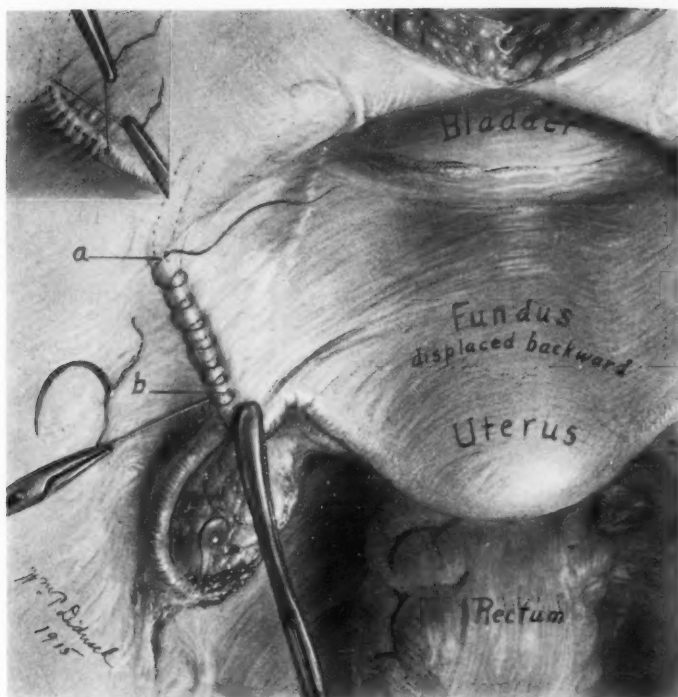


FIG. 1.—Shirring the round ligaments.

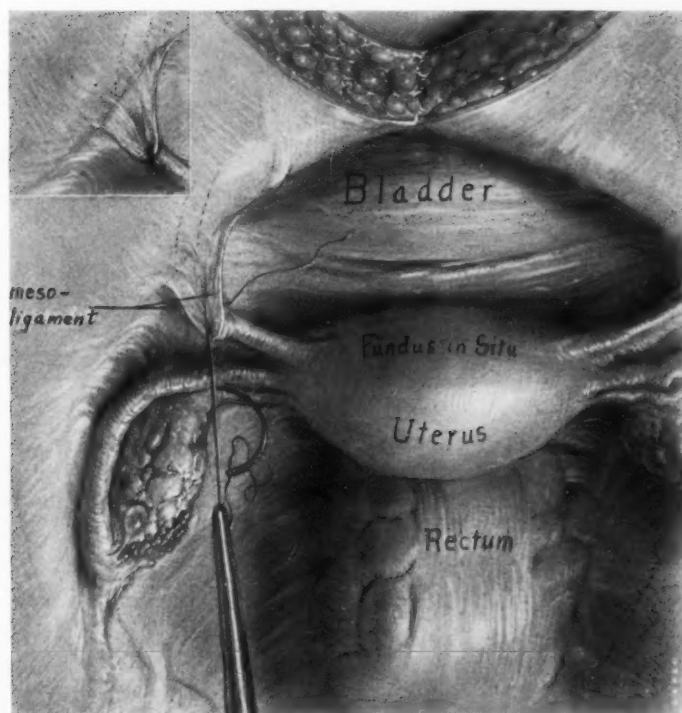


FIG. 2.—Shirred portion of ligament covered with mesoligament.

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SHIRRING THE ROUND LIGAMENTS

The exact point at which to catch the ligament is determined by estimating the amount of slack to be taken out of the ligament. On making traction upon the distal portion of the ligament with the forceps, from a half inch to an inch of the ligament will be pulled out of the inguinal canal. This is an essential part of the operation, as the sequel will show.

While tension is being kept up, a round needle, armed with linen or silk, is thrust through the ligament close to the pelvic brim, just at its exit from the internal inguinal ring (*a*). The needle is again put through the ligament about a quarter of an inch farther toward the fundus. This is repeated again and again, until sufficient length of the ligament has been sutured to insure the proper degree of shortening. The last puncture of the needle is usually made through that portion of the ligament which is traumatized by the bite of the forceps.

By pulling ever so lightly upon the ends of the suture the ligament begins at once to "shirr," as a dress-maker would say. This is seen distinctly in the insert. Shirring the ligament necessarily shortens it. You will observe that the points indicated by *a* and *b*, representing the extremes of the sutured portion of the ligament, approach each other. When the knot is tied it hugs up closely against the internal inguinal ring. If, perchance, sufficient of the slack in the ligament has not been taken up to tilt the fundus forward, one or more sutures can be introduced through the ligament, travelling always toward the uterus. The same needle and suture are used throughout the entire operation.

The operation might well be stopped here. In fact I had performed it many times before noticing that after tying the knot, gentle traction upon the suture develops a tiny *mesoligament* (Fig. 2). The base of this pseudomesentery springs from the pelvic wall. The major portion of it lies in front of the round ligament. This discovery gave me an idea; namely, that the peritoneal fold forming the mesoligament might be utilized as a cover for the shirred portion of the round ligament.

On trying out the suggestion I found it to be readily accomplished and with most satisfactory results. Catching the edge of the little meso with forceps it is pulled inward over the shirred portion of the ligament. While the meso is held in this position the same needle we started out with, armed with the same suture still uncut, is thrust through the mesoligament from below upward and another knot tied. Could anything be simpler? A little skill displayed here will hide even the last knot. I asked the artist, Mr. Didusch, to let the knot show in the illustration so that its position might be seen. The shirred portion of the ligament is hid entirely from view, and, what is better, out of reach of a troublesome intestine seeking an adhesive alliance.

JOHN WESLEY LONG

The operation as finished evinces a refinement of technic that appeals to the most æsthetic surgeon. It is also so exceedingly simple that a well trained operating-room nurse could perform it, under the guidance of the surgeon, of course.

I have employed the operation for three years or more. Having demonstrated to my own satisfaction both its feasibility and efficiency, I feel, in newspaper parlance, that it is time it should be "released for publication."

URETHROPLASTY AT THE BASE OF THE GLANS PENIS*

By COURTNEY W. SHROPSHIRE, M.D.

OF BIRMINGHAM ALA.

VISITING GENITO-URINARY SURGEON TO THE HILLMAN, ST. VINCENTS HOSPITAL AND THE BIRMINGHAM INFIRMARY
AND

CHAS. WATTERSTON, M.D.

ONE of the most troublesome conditions with which the surgeon has to deal is fistula along the course of the male urethra, and any means which science can devise for its relief will, we feel sure, be welcomed by the members of the medical profession as well as their patients.

The most delicate part of the male urethra, as far as perforating wounds are concerned, is at the base of the glans penis, for in this locality the urethra is hardly thicker than a sheet of writing paper, the essential structures being skin and mucous membrane. In addition to the weak physical structure the anatomic structure favors infections of a destructive nature, through inflammation of the peri-urethral glands internally, some of which open into the urethra at this point, and by means of infectious material being deposited during intercourse in the deep sulcus which presents on either side of the frænum externally.

In the course of urethral infections the peri-urethral glands can often be palpated between the thumb and index fingers at the base of the glans penis, the tumor ranging from the size of a grain of wheat to the size of a marble. The abscess can be opened into the urethra by means of a urethroscope or spontaneous rupture may take place into the urethra, the abscess cavity drained, and the condition be removed.

A certain percentage of these abscesses will open on the surface of the penis to the right or left of the frænum, perhaps on both sides, leaving a sinus so small as not to be noticed by physician or patient. Again, the inflammatory process may cause considerable destruction of tissue, with a resulting fistula ranging in size from three to twelve millimetres or more in diameter.

Externally, a syphilitic chancre often penetrates into the urethral canal near the frænum, in fact, it has been our experience that a chancre will in most cases penetrate the urethra if situated in the sulcus to the side of the frænum, unless treated energetically from the beginning.

* Read before the Jefferson County Medical Society, Birmingham, Alabama.

Fistulæ would be placed more under the head of troublesome than dangerous conditions, for there is little likelihood of their being the direct or predisposing cause of a severe lesion, but they are mutilating and brand a man as having been a sufferer from venereal disease, and we do our patients an injustice when we allow them to leave our care without this deformity being corrected.

The actual and apparent size of these fistulæ will vary greatly. A fistula not more than two or three millimetres in diameter on examination, will at operation have a ring of scar tissue surrounding it which must be removed, making the opening much larger. Our experience has been that it is practically useless to attempt to close these openings in the urethra by means of a purse-string or interrupted suture, unless we reinforce it with a plastic flap, for they invariably break down and the fistula is larger than it was previous to operation.

The following simple operation has given the best results in our work:

The urinary tract is rendered free of disease and some urinary anti-septic is administered for several days prior to operation. The parts are then cleansed and a straight sound passed into the urethral canal beyond the fistulous opening. The foreskin is now retracted by an assistant and an island of mucous membrane is marked off with its base toward the fistula opening, continuous with the mucous membrane of the urethra. This island should be slightly larger than the fistula to be closed. All scar tissue is now removed from the edges of the wound and a surface about one centimetre in width is denuded around the fistulous opening and the island of mucous membrane which has been preserved. A silk suture of the Halstead type is now placed in the outer edge of the denuded surface immediately above the fistulous opening. This suture is used as a retention suture and should be of medium silk doubled. The ends are now passed through the plastic flap in such a way as to bring the island of mucous membrane into the fistulous opening when they are tied (Fig. 1, C, suture No. 1). Other sutures of the Halstead type are placed so as to completely surround the wound at the outer edge of the denuded surface, the ends being passed through the flap but not tied (Fig. 1, C, sutures Nos. 2, 3, 4, and 5). A second row of sutures are now placed around the opening similar to the above, but on the inner edge of the denuded surface; these ends are also passed through the flap.

While these sutures are being inserted an assistant should control oozing as much as possible by means of hot packs applied to the denuded surface.

URETHROPLASTY AT BASE OF GLANS PENIS

The retention suture is now tied—not too tightly—this being followed by the tying of the other sutures passed through the flap (Fig. 1, D). The sound is removed, a rubber retention catheter placed in the bladder, and the patient put to bed.

The following case histories will illustrate the usual cause and treatment:

CASE I.—W. M., male, aged forty-seven, constable, referred by Dr. Spencer.

Three weeks ago the patient noticed a small sore on the right side of the frænum, which rapidly grew worse even though washed and dressed twice daily. Called on Dr. Spencer and was referred to us for treatment. Examination revealed a sore on right side

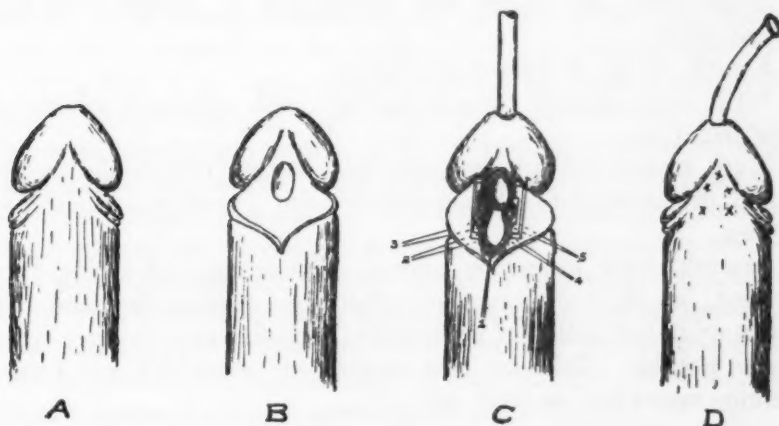


FIG. 1.—A, normal penis; B, fistula with destruction of frænum; C, sutures *in situ*; D, sutures tied.

of frænum which involved lower part of same, extended to opposite side, and entered urethra. Dark field examination *Spirochæta pallida*. Patient was given four intravenous injections of salvarsan, 0.3 to 0.6 Gm. to the dose, followed by mercurial treatment. Two months later Wassermann reaction negative. Operation at Birmingham Infirmary December 15, 1915, urethroplasty, using foreskin flap, restoring normal outline of penis. On the third day after operation patient was given 0.3 Gm. of salvarsan to destroy any organisms that may have been released by cutting into old scar. Results, primary union, patient left hospital on tenth day. Penis looks normal.

This case is interesting for the following reasons:

First, the size of the fistula which would easily admit the end of the index finger.

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Second, the fact that the frænum was completely destroyed before the chancre healed, rendering operation more difficult.

Third, the wound healed by first intention when the tissue operated on had recently been the site of syphilitic sore.

CASE II.—J. D., male, aged thirty-five, telegraph operator.

Gonorrhœa five years ago with peri-urethral abscess opening to left of frænum. Examination revealed small fistulæ about three millimetres in diameter. Operation, July 5, 1915, resulted in complete recovery, slight scar remaining.

In conclusion we wish to say that in doing this work the following points should be observed:

First, have the urethral tract free of disease.

Second, control oozing as much as possible with hot packs.

Third, place all sutures with lower part U parallel with long axis of penis.

Fourth, do not tie sutures too tightly.

Fifth, wash bladder through catheter with saturated solution of boric acid daily.

Sixth, remove the catheter every other day and irrigate the urethra, without distention, with solution of boric acid. Do not use a mushroom catheter.

Seventh, dress wound by painting with tincture of iodine, three per cent., on third day, remove catheter on seventh day, and have patient drink half gallon of water daily, beginning as soon after operation as possible. Take out first sutures on fourth day and remove retention suture last, on tenth day.

THE PATHOLOGICAL DIAGNOSIS OF DISEASES OF THE APPENDIX BASED ON THE STUDY OF 1500 SPECIMENS

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My purpose in this paper is twofold. First, to try to clarify, if I may venture to say so, some of the current notions concerning the pathology of appendicitis; and second, to demonstrate and establish definite criteria by which disease of this organ may be recognized. The classical monograph of Aschoff on the pathology of appendicitis covers the ground so fully as to almost prohibit any further contribution to this subject. Unfortunately, Aschoff's work seems to be known largely by title only, as any one conversant with the current notions of the pathology of appendicitis can testify. Witness, for instance, the remarkably confused terminology of this disease. The terms, catarrhal, both acute and chronic, gangrenous, ulcerative, and perforative appendicitis are employed with a looseness that displays altogether insufficient acquaintance with the meaning of these terms and their relationship to inflammations of the appendix. Furthermore, these terms are conventionally employed to connote different maladies, with only a vague notion that they represent phases of a single pathological process.

As an inevitable consequence of this vagueness concerning the pathology of appendicitis, the gross diagnosis, as to whether the removed organ is diseased or not, leaves much to be desired, from the average surgeon's view-point; and if his instinct, if you may call it such, leads him to pronounce the appendix diseased, he is frequently unable to indicate his reasons therefor. To recognize that an appendix is diseased or normal, the microscope, as I shall show, is by no means always necessary. I believe that in 90 per cent. the diagnosis of a present or previous appendicitis may be easily recognized by the naked eye.

In the first place, I hold that the conventional method of longitudinally slitting the organ to determine if and to what extent the appendix is diseased, is wrong. Obliterations and strictures are sometimes overlooked in this way because the trauma often destroys the lumen, so that we are unable to tell what is lumen and what is obliteration. In acute appendicitis, the longitudinal method is not so apt to lead to mistakes,

but it does not enable us to diagnose with as much accuracy the duration of the lesion as by the method I recommend. This method consists in simple transverse incisions made at various levels. By such incisions we are able to tell accurately the quantity and topography of the exudate; the width and conformation of the lumen; or whether there is a lumen at all; the relation of the mucosa to the muscularis, which, as I shall show, is an important diagnostic item; and, finally, the extent of the infiltration of the coats. The objection may be raised that by transverse incisions we may miss a lesion. This I have not found to be valid; first, because the vast majority of lesions of the appendix are found in the terminal portion; and second, because the lesions, as a rule, are simple, extend over a broad area, and have some external deformity to serve as guide.

My own contribution to this subject, aside from my attempt to popularize Aschoff's teachings, is: first, to afford a systematic interpretation and exposition of the disease, so that the lesion may be more easily recognized grossly; second, to add a number of new diagnostic features to the pathogenesis of appendicitis; and third, to correlate, as far as my opportunities have allowed me, the lesion with certain clinical phenomena.

I have purposely avoided any discussion of certain of the gross lesions of the appendix, such as kinks, adhesions, etc., for the reason that such lesions are no longer present when the specimen is referred to the laboratory for examination. This omission does not imply that I do not concede the profound importance of these lesions in the etiology of appendicular disease.

Normal Appendix.—The appendix varies widely within normal limits, as regards size, shape of lumen, number of crypts, abundance of lymphatic apparatus and thickness of muscular coats. Some of these variations are dependent upon age; appendices in the young, for instance, being richer in lymphatic apparatus than in the adult. But the other variations do not appear to depend upon any other factor.

Figure 1 (3742), however, presents the sectional appearance of an average normal appendix. Note that the lumen contains four crypts lying between corresponding projections of mucosa. The lumen is lined by the high cylindrical epithelium peculiar to the intestinal tract; the epithelium forms glands which are most abundant in the projections of the mucosa, becoming less in number as we approach the bases of the crypts. The stroma of the mucosa is rich in lymphatic tissue in certain places, especially within the projections and around the base of the mucosa, this tissue is more compactly arranged and embraces a more translucent round area containing larger lymphoid cells, the so-called "chyme centres." The lymphoid tissue is identical in structure with the other lymphoid tissue of the body, such as the lymph-glands, tonsil, etc.

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Between the mucosa and the muscularis is a rather narrow zone consisting of fibrous areolar tissue, fat tissue, blood and lymphatic vessels and a sparse scattering of round lymphoid cells. I lay special stress upon the width of this submucous zone because, as we shall see, its width is an important diagnostic point in the gross diagnosis of certain forms of chronic appendicitis. Proceeding outward, we find the two muscular layers of the appendix, embracing within their muscle fibres groups of sympathetic ganglion cells. Beyond this is the narrow zone of subperitoneal connective tissue, containing many blood- and lymphatic vessels. Finally, we come to the peritoneal coat consisting of a delicate single layer of endothelium. The lumen of the appendix is empty or contains a small amount of faeces and traces of mucus; the mesentery of the appendix consists of fatty tissue and many blood- and lymphatic vessels, which penetrate the muscular coats of the appendix.

Acute Suppurative Appendicitis.—Fig. 2 (3784). Lesion during first twelve to twenty-four hours.

The type of lesion represented in this figure is the primary lesion of all forms of appendicitis, just as the chancre is that of syphilis. *Appendicitis begins in no other way than as here represented.* The genesis of this lesion furthermore forms the keynote to the interpretation of the pathological anatomy of every lesion of the appendix, both acute and chronic. I shall therefore describe this lesion in detail.

First, we note that from the bases of two of the crypts, there spring forth two projections of membrane or exudate, containing fibrin and many pus and red blood-cells, which meet in the centre of the lumen. Note also that the epithelial lining is completely absent at the bottom of the crypts so that the membrane of the exudate appears continuous with the lymphoid stroma. On the other hand, although the exudate spreads to the very base of the remaining crypt of the appendix, the epithelial lining in this crypt is nevertheless intact, showing that the exudate did not originate there. We note also the dilatation of the blood-vessels within the mucosa, most marked at the prominences. The submucous, muscular and subperitoneal connective tissue coats are already infiltrated with numerous polymorphonuclear lymphocytes, while the subperitoneal blood-vessels are markedly injected. Note that a well defined peritonitis is already present. The endothelial layer is completely absent and the surface is covered by a thin layer of exudate, of the same morphology as that within the lumen.

I emphasize the early appearance of a localized appendicular peritonitis because it is not generally appreciated that a local peritonitis is already present in the early stages of the disease. I have never seen an appendix acutely inflamed that did not show this lesion, although I confess that I do not recall ever having examined an appendix removed in the first twelve hours after the onset of symptoms. *Without any further evidence, therefore, the absence, even grossly, of a localized appendicular peritonitis, practically excludes an acute appendicitis.*

I also call attention to the entire freedom of the lymphatic apparatus from the infective invasion. These structures have a peculiar immunity in all acute inflammations of the appendix and are the last

structures to be destroyed by the infective process. The mesenterium is normal.

Twelve to Twenty-four Hour Lesion.—Fig. 3 (3183). This lesion is slightly more advanced than the preceding. The membrane is more extensive and fills up almost the entire lumen of the mucosa. The destruction of the lining epithelium has become so extensive that it persists only over the prominences of the mucosa. The infiltration of the coats with polymorphonuclear cells is more extensive, so that it is more difficult to distinguish the muscular coats. The mesenterium is also extensively infiltrated with pus-cells and the blood-vessels are injected. There is a well-marked peritonitis.

Twenty-four to Forty-eight Hour Lesion.—Fig. 4 (3108). This specimen represents a still more advanced process. The exudate now completely fills the entire lumen. The mucosa has been completely destroyed except for two small projections on one side. The lymphatic apparatus now shows purulent infiltration. Many of the lymph-vessels in the submucosa are filled by polymorphonuclear cells (lymphangitis). There is extensive oedema of the muscular coats. The infiltration of the coats with polymorphonuclear cells is very extensive. Localized peritonitis.

Twenty-four to Forty-eight Hour Lesion.—Fig. 5 (3046). A still more advanced lesion. The exudate has now partly broken down leaving a rather large lumen. The mucosa is still represented by a small prominence upon one side. Scattered throughout the exudate are colonies of bacteria. Remains of the lymphatic apparatus are still noticeable near the base of what once was the mucosa. The infiltration of the muscular coats is so extensive that their definition is difficult. The remaining lesions are the same as the preceding.

Forty-eight to Seventy-two Hour Lesion.—Fig. 6 (3183). A still more advanced stage. The mucosa has now completely disappeared. The faint staining, absence of nuclei and karyorrhexis in the exudate indicate a profound necrosis. The purulent infiltration of the muscular coats is now so extensive as to completely mask the histological structure. Otherwise the lesions are those of the preceding.

Lesion of Forty-eight or More Hours.—Fig. 7 (3106). Complete necrosis of all coats of appendix.

Perforation.—Fig. 8 (3689). The appendix shows the changes associated with a long duration—forty-eight to seventy-two hours. The mucosa is completely destroyed and the lumen filled up with exudate. On one side we note a broad space where the walls of the appendix are absent; this space is filled by a plug of exudate continuous with that in the lumen. Attention is called to the mesentery which, while extensively infiltrated with pus-cells, shows no thrombosis.

Comment.—This is the typical pathological picture in acute perforations of the appendix. It is evident that the process is not a peculiar one, but incident to the same acute suppurative process above described. Acute perforations are, in my opinion, due to the direct destructive action of the bacteria upon the wall of the appendix, associated with extensive tension on the part of the exudate within the lumen. I believe thrombosis

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of the mesenteriolum plays little rôle in its etiology, because I have never found it in such cases.

All the perforations of the appendix I have studied are associated with the characteristic lesions of the later stages of the disease, when the entire circumference of the mucosa has been completely destroyed and the infiltration of the walls is very profound. I realize full well, that perforations have been found in the first twenty-four hours of the malady, but as yet I have not seen it in the laboratory. In passing, I may say that perforations of the appendix are at present uncommon, due, probably, to early operations.

Empyema of the Appendix.—Fig. 9 (6262). The lumen is enormously dilated. The superficial epithelium of the mucosa is completely absent; that of the glands is degenerated and extensively desquamated. The stroma of the mucosa is congested and cedematous; the lymphoid apparatus is intact. All the remaining coats show extensive infiltration with polymorphonuclear leucocytes. The peritoneum, however, shows no fibrin covering, indicating that there is no acute peritonitis.

Comment.—This picture, while resembling in many particulars that of the lesion of acute suppurative appendicitis, is nevertheless quite different. There is no formation of exudate and in consequence no profound necrosis and ulceration. The ulceration is superficial and due entirely to the loss of epithelium. Furthermore, there is no acute peritonitis, a phenomenon, as I have shown, incident to practically every acute inflammation of the appendix.

How, then, are we to interpret this lesion? The facts are that this section was taken from a hugely dilated bulbous tip of the appendix. At the neck of this bulb the appendix revealed a typical acute suppurative appendicitis. The pus formed in this area flowed into the bulbous tip, creating a so-called empyema. The changes in the mucosa, just described, are due entirely, in my opinion, to the notorious fermentative action of the purulent contents, and not to bacterial infection. The infiltration of the coats with polymorphonuclear leucocytes is probably more the accompaniment of the acute suppurative inflammation above, rather than the result of irritant action from the immediate mucosa. This surmise is rendered more probable by the absence of localized peritonitis.

This lesion is typical in my experience of empyema of the appendix. In other words, an empyema of the appendix is usually the result of a secondary purulent collection within a previously formed dilatation of the appendix, rather than a primary suppuration and consequent breaking down of an acute suppurative appendicitis. Very often, also, the acute suppurative lesion heals; the purulent collection in the dilated

portion remains, and usually causes sufficient irritation to demand removal of the organ. This is why empyemata of the appendix are commonly found in interval operations. On the other hand, I have seen true empyemata occurring in dilated appendices, in which the lesion was precisely that of acute appendicitis.

Mesenteriolum.—In every acute appendicitis there is profound infiltration of the fatty tissues of the appendix with polymorphonuclear leucocytes; this infiltration becomes progressively more extensive the longer the duration of the illness. It is difficult to determine the presence or absence of thrombosis of the mesenteriolum by microscopic examination, for the reason that histologically it is practically impossible to determine whether the thrombus is ante- or post-operative. Of course, I refer only to early thrombi. I have seen but one case of late thrombosis, occurring in a case of pyelophlebitis of the portal vein.

Summary of Acute Suppurative Appendicitis.—The pathological anatomy of acute appendicitis, as I have attempted to picture it, leads to many reflections.

1. It affords every ground for presuming, as Aschoff insists, an enterogenic as opposed to a hæmatogenous infection of the organ. This is evidenced by the invariable origin of the lesion from the mucosa. I have never seen an acute local infection of any of the tissues of the appendix unassociated with the mucosal lesion that I have described, a phenomenon that manifestly excludes a hæmatogenous origin of appendicitis. This is a rather broad statement, since a hæmatogenous origin for acute appendicitis has often been seriously held; but I believe this contention is sound.

2. The lesion of acute appendicitis is *not* a catarrhal inflammation as understood in the pathological sense. Indeed, *acute and even chronic catarrhal inflammations of the appendix do not occur*. The term "catarrhal" inflammation as far as the appendix is concerned, therefore, is a misnomer and should never be employed.

3. Can we interpret the pathogenesis of acute appendicitis in terms of lesions here described? I believe all we can safely assert is, that it is a bacterial infection and that the lesion starts in the crypts because stagnation is more likely to occur in these areas. The fact that approximately nine-tenths of the lesions of acute appendicitis occur at the tip of the appendix, where stagnation is most apt to occur, lends support to this hypothesis. This fact also makes untenable the contention, advanced by some, that appendicitis is occasionally due to a cæcitis or lesion of the so-called Gerlach's valve, thus interfering with the drainage of the organ. The lesions obviously throw no further light upon the

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direct etiology of acute appendicitis. The necrosis of the walls or, as conventionally termed, the "gangrene," is, to my view, largely due to the action of bacteria; thrombosis of the blood-vessels in the mesenteriolum is altogether too uncommon a lesion to be a large factor.

4. The pathological lesion fairly corresponds to the duration of the illness, as I have tried to show. But it is not uncommon to cut appendices in which we find various stages of the process, from the earliest to the more advanced. This simply means that the infective process starts at one point and spreads gradually to other points. I have never seen this spreading occur except by direct continuity.

5. The lesion of acute appendicitis is a membranous inflammation or, more familiarly termed, a diphtheritic inflammation. This type of inflammation need not be regarded as peculiar to the appendix, because a membranous inflammation is the rule in all of the acute inflammations of the mucous membranes of the body. Nothing, for instance, can be more striking than the absolute identity of the lesions of both acute follicular tonsillitis and acute appendicitis. In tonsillitis, the crypts, corresponding to the sulci within the appendix, are filled with a membranous exudate; there is the same loss of epithelium in the crypts, the same comparative immunity of the lymphatic structures lying between the crypts and the same infiltration of the tissues. Thus far, however, the similarity ends, because acute tonsillitis nearly always ends in complete restitution of the organ, while in appendicitis, necrosis, and if recovery occurs, scar formation are frequent sequelæ. I can account for this only by the different circulations of the two organs, that in the tonsil being anastomotic, while in the appendix it is terminal.

The diphtheria caused by the Klebs-Löffler bacillus, acute cholecystitis, acute enteritis, typhoid fever, etc., have precisely the same pathological anatomy I have described for acute appendicitis.

6. *Onomatology*.—The characteristic feature of acute appendicitis is an infection and invasion by polymorphonuclear leucocytes, so that the term "acute suppurative appendicitis" from the pathological viewpoint is the one most applicable and covers every requirement. The conventional terminology of acute appendicitis is, as I have already remarked, both various and confusing. We often hear the terms "acute catarrhal," "acute gangrenous," and "acute ulcerative" appendicitis. These terms, however, are inaccurate, in the pathological sense. "Catarrhal appendicitis," as I have already shown, does not exist. The term "gangrenous" is one that offers a wide latitude in its interpretation; moreover, with the microscope it is often difficult and sometimes impossible to assert that the tissues of the appendix are dead beyond

hope of regeneration. The term "ulcerative" is bad because there is no loss of tissue, except in the terminal phases of the infection. For these reasons I plead for the conception of acute appendicitis as a suppurative process.

Healing Appendicitis.—Fig. 10 (2916). Upon one-half of the lumen, the mucous membrane is congested, but intact, and contains a large lymph centre. The remaining half is lined by a mass of young granulation tissue covered on its surface by partly necrotic exudate. There is still a small amount of comparatively fresh exudate within the lumen. At the junction of the two surfaces the surface epithelium from the intact mucosa has spread for a short distance to either side, upon the newly-formed granulation tissue. The walls of the appendix are cedematous and still show extensive infiltration with polymorphonuclear leucocytes, but in addition there are a large number of round and plasma cells. The fibrin on the peritoneal surface has almost completely disappeared, and has been replaced by a soft cedematous tissue that shows beginning organization. The peritoneal blood-vessels are injected.

Comment.—The lesion can be interpreted as follows. In this appendix the acute suppurative process was arrested comparatively early; before the entire mucous membrane was destroyed. The exudate that destroyed the remainder has broken down, leaving a comparatively broad ulcer which, as the granulation tissue indicates, shows unmistakable evidence of beginning healing. The lumen is in the process of restoration by an extension of epithelium proceeding from the intact mucosa over the base of this ulcer. Further evidences of healing are the disappearance of polymorphonuclear leucocytes in the walls, the appearance of round and plasma cells, and the beginning organization of the peritoneal exudate.

Fig. 11 (2967). This appendix reveals a somewhat later stage of the healing process. On one side of the small lumen a very small area of intact mucosa is seen. The remaining part of the wall of the lumen is lined by a richly cellular granulation tissue. The surface epithelium, as in the previous specimen, has already spread along the surface of this new granulation tissue for a considerable extent. Note the persistence of many foci of lymphatic tissue. The polymorphonuclear infiltration of the walls has almost completely disappeared. On the other hand, the muscle fibres are completely disorganized and the bundles are separated from one another by young new connective tissue. The peritoneal coat is very thick, cedematous, and shows a fairly advanced connective tissue organization.

Fig. 12 (2967). Another portion of the same appendix. In this area the mucosa has been completely destroyed, and the lumen is filled with characteristic new granulation tissue. Otherwise the lesion is the same as the preceding.

Fig. 13 (3205). This appendix represents a more advanced stage. The mucosa has been completely destroyed; the granulation tissue is firmer, as

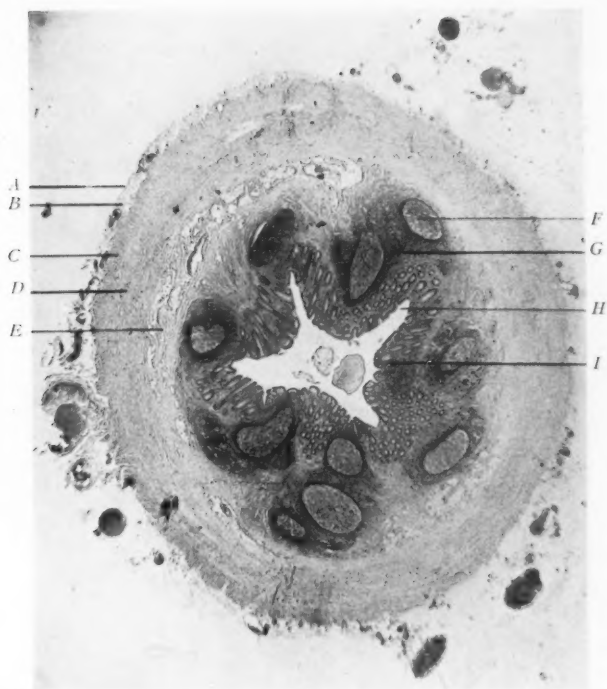


FIG. 1.—Cross-section of normal appendix. *A*, peritoneal coat; *B*, subperitoneal connective tissue; *C*, external muscular layer; *D*, internal muscular layer; *E*, submucous connective tissue; *F*, chyme centres; *G*, lymphoid tissue; *H*, crypts; *I*, mucosa.



FIG. 2.—Acute appendicitis; twelve- to twenty-four-hour lesion. *A*, mucosa, showing congestion and slight blood extravasation; *B*, masses of exudate springing from the crypts; *C*, base of crypt showing intact mucosa; *D*, muscular coats infiltrated with polymorphonuclear cells; *E*, fibrinous exudate covering peritoneum, *i.e.*, localized peritonitis.



FIG. 3.—Acute appendicitis, twelve- to twenty-four-hour lesion. *A*, intact mucosal prominences; *B*, exudate; *C*, submucous connective tissue infiltrated with polymorphonuclear leucocytes; *D*, muscular layers infiltrated with polymorphonuclear leucocytes; *E*, localized peritonitis.



FIG. 4.—Acute appendicitis, twenty-four- to forty-eight-hour lesion. *A*, intact mucosal prominence; *B*, exudate; *C*, remnants of lymphoid tissue; *D*, muscular layers; *E*, localized peritonitis. All the coats are densely infiltrated with polymorphonuclear leucocytes.



FIG. 5.—Acute appendicitis, twenty-four- to forty-eight-hour lesion. *A*, intact mucosal prominence; *B*, exudate which has broken down in the centre leaving lumen *C*; *D*, masses of bacteria; *E*, muscular layers so densely infiltrated with polymorphonuclear leucocytes that their definition is difficult; *F*, localized peritonitis.



FIG. 6.—Acute appendicitis, forty-eight- to seventy-two-hour lesion. *A*, exudate; *B*, muscular layers; *C*, localized peritonitis.

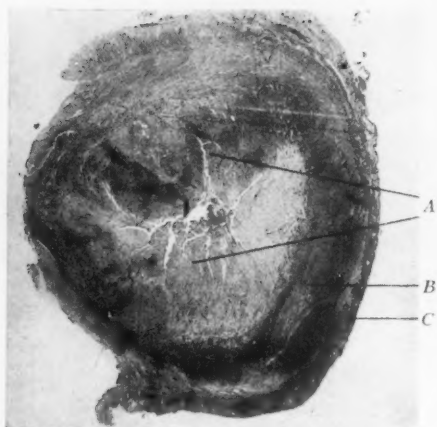


FIG. 7.—Acute appendicitis, lesion of forty-eight or more hours. *A*, necrotic exudate; *B*, muscular layers almost completely necrosed; *C*, localized peritonitis.



FIG. 8.—Acute appendicitis with perforation; late lesion. *A*, exudate; *B*, perforation; *C*, mass of fibrin blocking perforation; *D*, muscular coats.

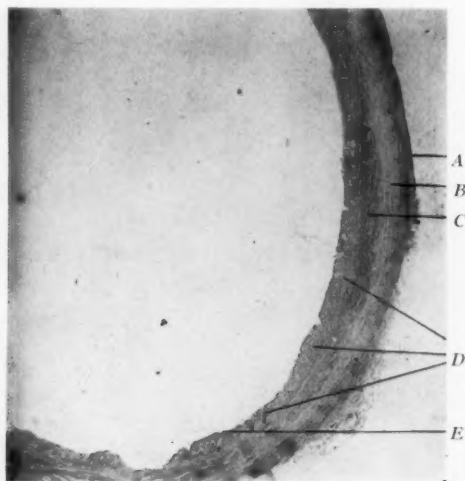


FIG. 9.—Acute appendicitis; "empyema" of appendix. *A*, normal peritoneum; *B*, muscular coats slightly infiltrated with polymorphonuclear leucocytes; *C*, intact lymphoid tissue; *D*, mucosal glands, many of which show degeneration of the epithelium; *E*, lining epithelium almost completely absent.

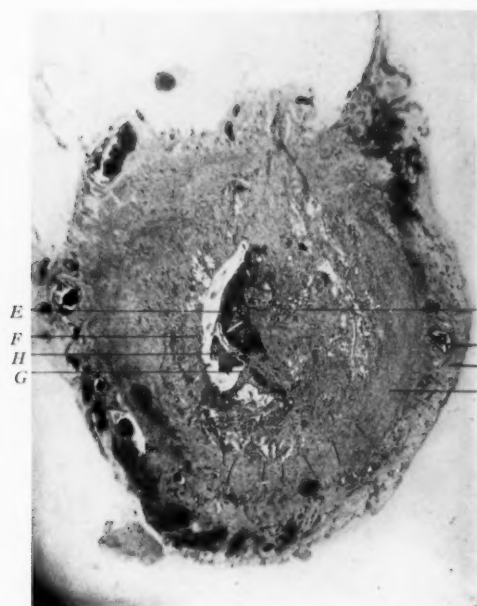


FIG. 10.—Healing appendix. A, peritoneal and subperitoneal coats showing connective tissue organization; B, dilated blood-vessels; C, muscular layer infiltrated with young connective tissue; D, infiltrated submucous coat; E, congested mucosa; F, base of broad ulcer consisting of granulation tissue; G, epithelium beginning to spread over lateral edges of ulcer; H, free exudate in lumen.

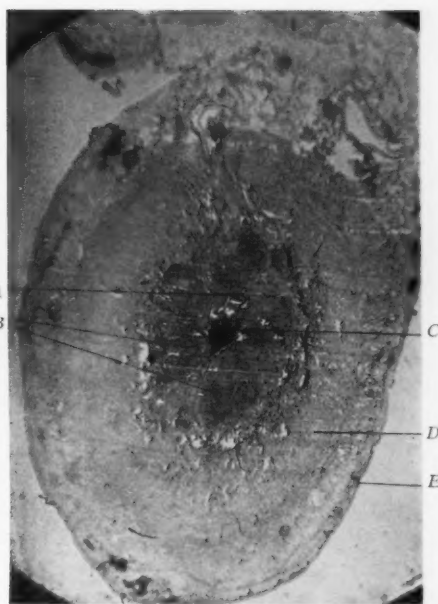


FIG. 11.—Healing appendix. A, small remnant of mucosa; B, granulation tissue filling lumen of appendix; C, exudate; D, muscular coats infiltrated with young connective tissue; E, organizing peritonitis.



FIG. 12.—Healing appendix. A, granulation tissue; B, muscular coats showing fairly advanced connective tissue organization between the muscular fibres; C, organizing peritonitis.



FIG. 13.—Healing appendix. A, almost completely organized granulation tissue filling lumen of appendix; B, muscular coats infiltrated with the same tissue.



FIG. 14.—Healing appendix. *A*, almost completely organized granulation tissue filling lumen; *B*, muscular coats infiltrated with the same tissue; *C*, organizing peritonitis.

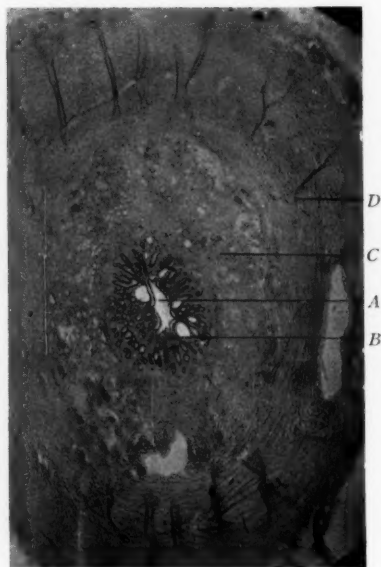


FIG. 15.—Healed appendix; stricture. *A*, small and almost cryptless lumen; *B*, mucosa; *C*, broad submucous connective tissue zone; *D*, muscular coats infiltrated with new connective. Note sparseness of lymphoid tissue.

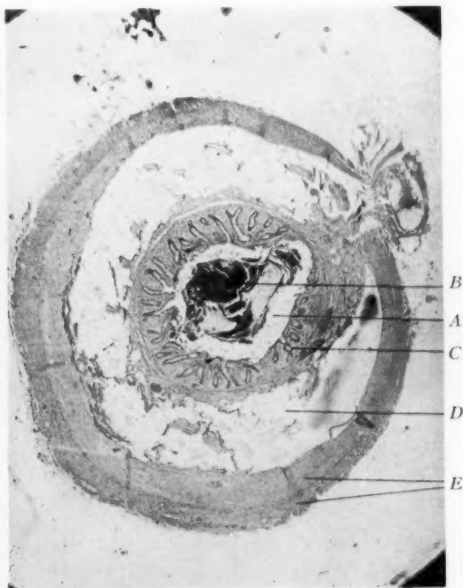


FIG. 16.—Healed appendix; stricture. *A*, narrow cryptless lumen, containing mucus and fresh blood; *B*, *C*, mucosa; *D*, broad and extremely attenuated submucous connective tissue zone; *E*, muscular coats.

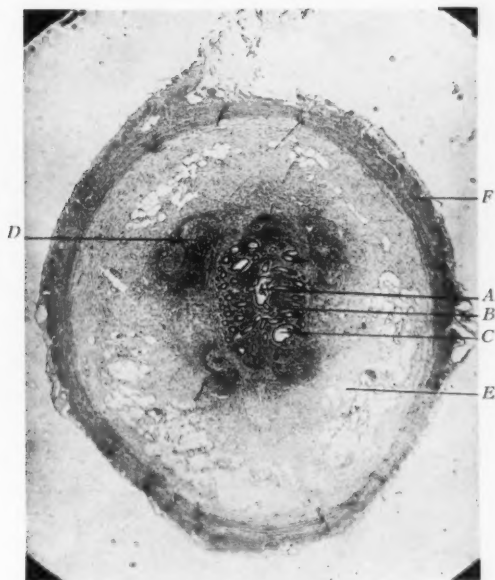


FIG. 17.—Healed appendix; stricture. *A*, small cryptless lumen; *B*, mucosa; *C*, dilated mucous gland; *D*, lymphoid tissue; *E*, broad submucosa; *F*, thinned muscular layer.

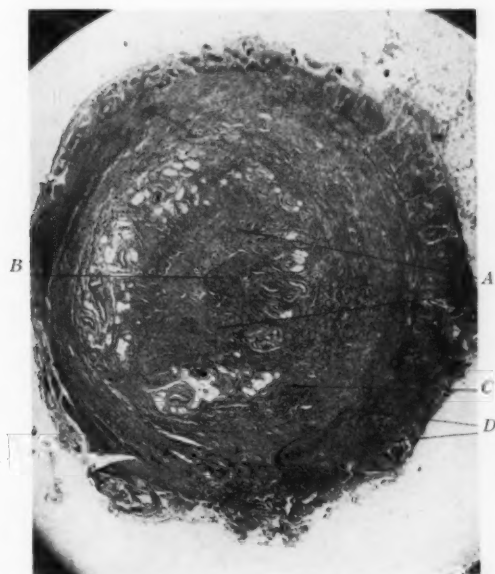


FIG. 18.—Healed appendix; obliteration. *A*, fibrous connective tissue filling lumen; *B*, remnant of lymphoid tissue; *C*, broad submucosa; *D*, deformed and infiltrated muscular coat.

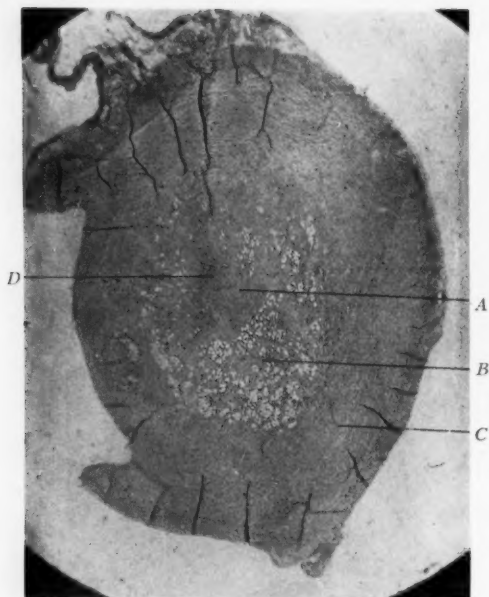


FIG. 19.—Healed appendix; obliteration. Firm fibrous tissue filling lumen. *B*, broad submucous connective tissue zone; *C*, infiltrated and deformed muscular layers; *D*, remnants of lymphoid tissue.

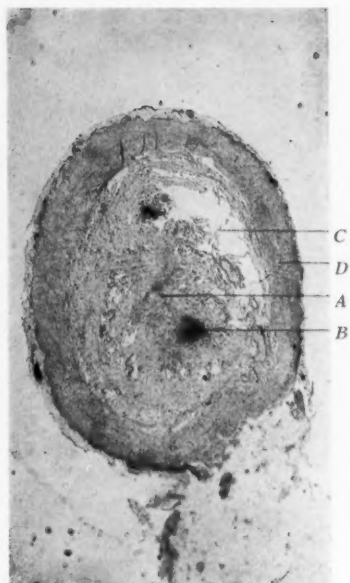


FIG. 20.—Healed appendix; obliteration. *A*, firm fibrous tissue filling lumen; *B*, remains of lymphoid tissue; *C*, broad submucous connective tissue zone; *D*, infiltrated muscular layers.

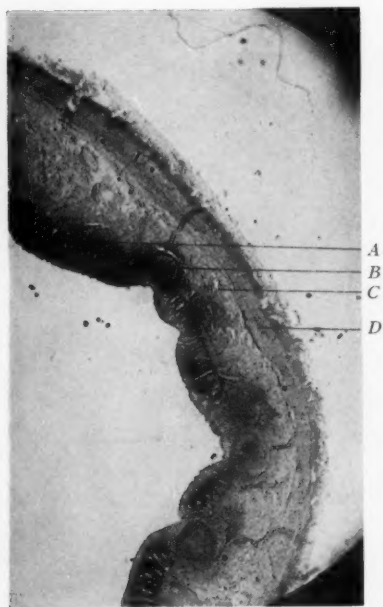


FIG. 21.—Submucous traumatic hemorrhages in appendix. *A*, mucosa showing blood extravasations; *B*, lymphoid tissue; *C*, submucous connective tissue zone; *D*, muscular layers.



FIG. 22.—Submucous traumatic hemorrhages in appendix. *A*, mucosal blood extravasation showing penetration through the superficial mucosa; *B*, normal mucosa.



FIG. 23.—Coprolith. *A*, coprolith; *B*, intact superficial mucosa. Note rubbing away in other portions. *C*, mucosal glands; *D*, lymphoid tissue; *E*, submucous connective tissue zone; *F*, thinned out muscular layers.

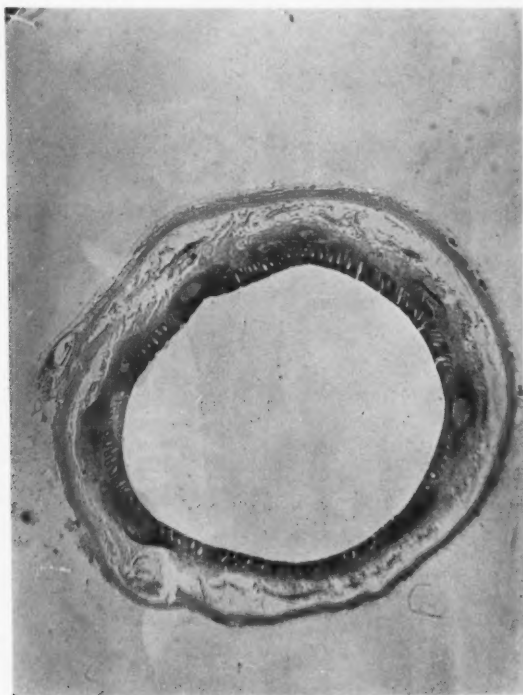


FIG. 24.—Appendix dilated from coprolith. Note intact lining epithelium.

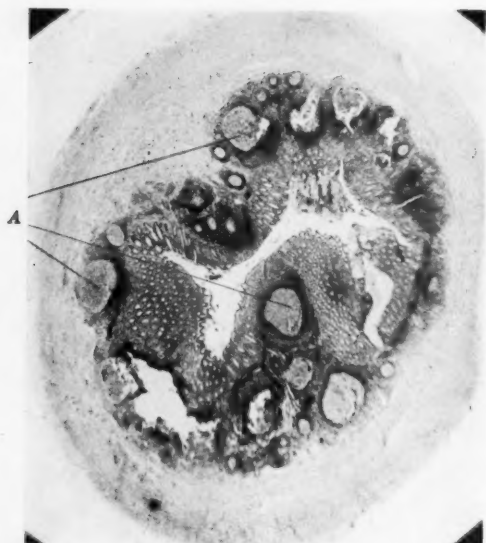


FIG. 25.—Lymphoid hyperplasia of the appendix. A, chyme centres surrounded by masses of lymphoid tissue.

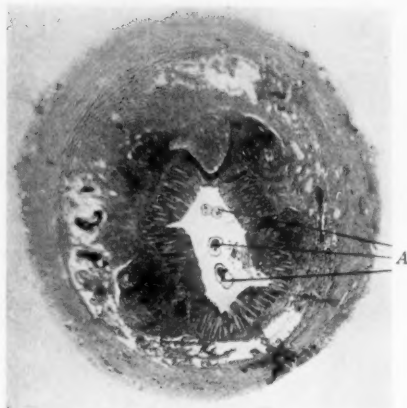


FIG. 26.—Oxyuris in appendix. A, cross-sections of oxyuris. Note intact mucosa. Appendix normal.

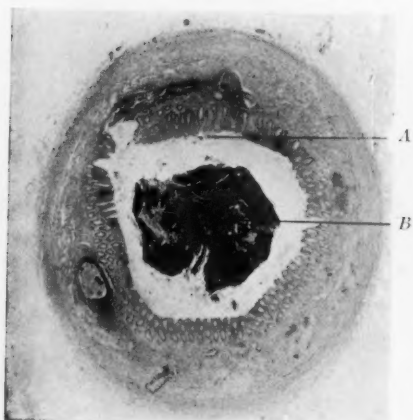


FIG. 27.—*Trichocephalus dispar* in appendix. A, cross-section of trichocephalus partially imbedded in superficial epithelium; B, fresh blood in lumen.

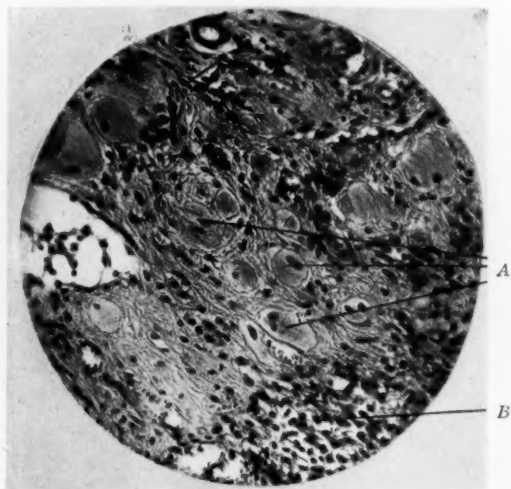


FIG. 28.—Decidua reaction of subperitoneal connective tissue (high power). A, decidual cells; B, normal round-cells.

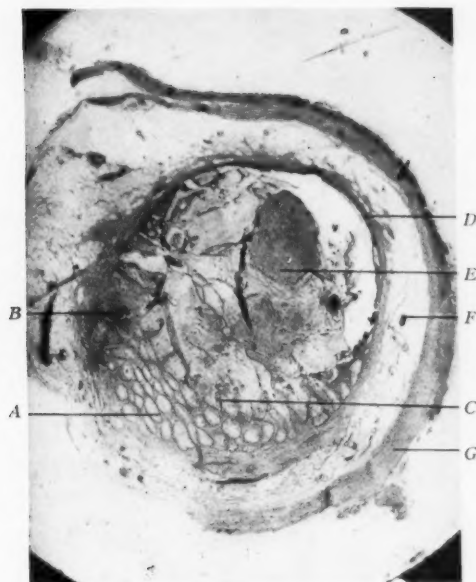


FIG. 29.—Intra-appendicular mucocoele. A, large mucosal glands, in which nearly all the cells are of the mucous or goblet type; B, lymphoid tissue; C, papilla-like projections of the mucosa; D, portion of lumen lined by single layer of epithelium; E, mucus; F, broad submucous connective tissue coat; G, infiltrated and deformed muscular layers.



FIG. 30.—Extra-appendicular mucocoele. A, firm connective tissue obliterating lumen; B, hiatus in muscular coats; C, connective tissue plug over hiatus; E, mucocoele.

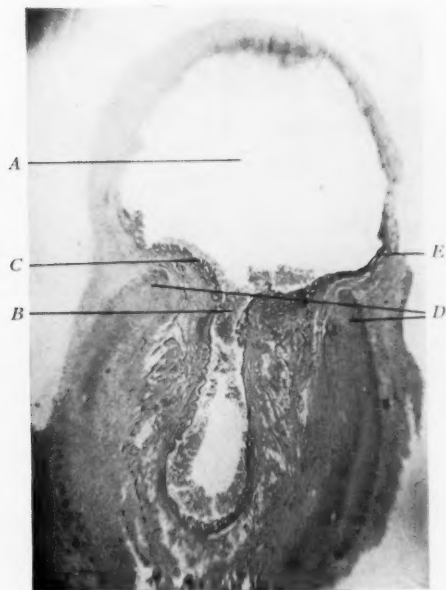


FIG. 31.—Diverticulum of the appendix. A, diverticulum; B, communication between diverticulum and lumen; C, mucosa lining diverticulum; D, end of muscular coats; E, single layer of epithelium lining remainder of diverticulum.

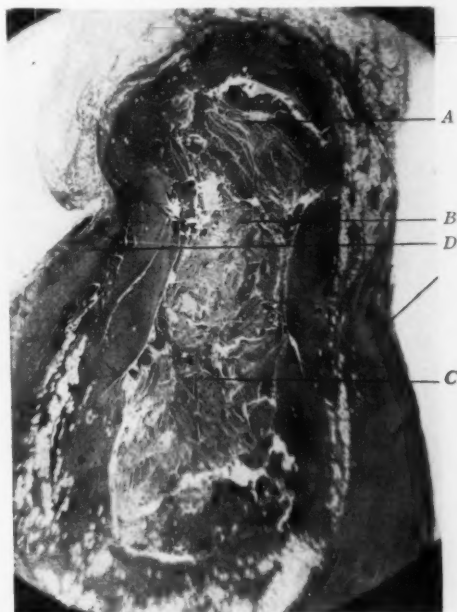


FIG. 32.—Acute appendicitis within a diverticulum of the appendix. A, lumen of diverticulum filled with fresh exudate; B, communication between diverticulum and lumen; C, lumen filled with fresh exudate; D, ends of muscular layers.



FIG. 33.—Scirrhous carcinoma of the appendix. A, carcinoma; B, submucous connective tissue zone; C, normal muscular layers; D, entrance of blood-vessel into appendix.

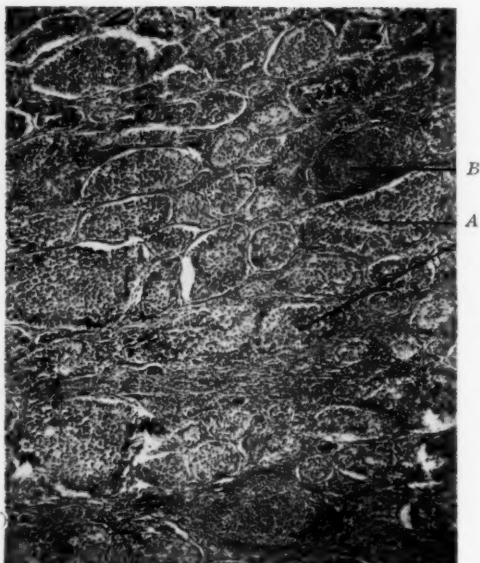


FIG. 34.—Medullary carcinoma of the appendix. A, carcinoma; B, lymphoid tissue.

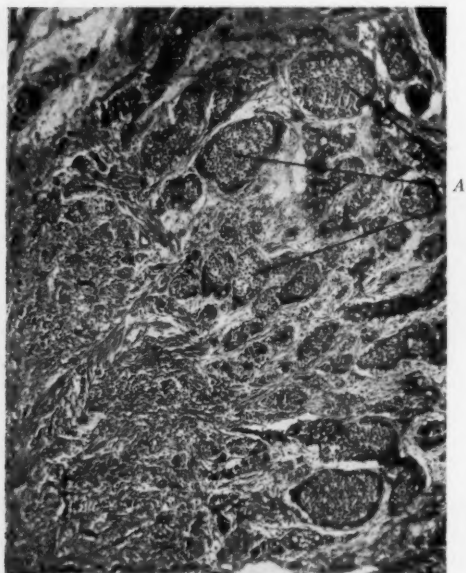


FIG. 35.—Carcinoma of appendix with acute appendicitis. A, carcinoma.



FIG. 36.—Adenocarcinoma of the appendix. A, adenocarcinomatous mass filling lumen; B, intact mucosa.

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evidenced by the more fibrous organization. The organization of the new connective tissue in the muscular and peritoneal coats is more nearly complete, consisting of firm tissue with few cellular elements.

Fig. 14 (3187). This represents a nearly completely healed appendix. The granulation tissue still contains a considerable number of cellular elements, indicating that complete organization has as yet not taken place. The same is true of the new connective tissue in the muscular and peritoneal coat.

Summary of the Lesions of Healing Appendicitis.—These appendices reveal a progressive healing, in which each stage of the process may be traced from the ravages of the acute attack. The course of events is the following: The exudate or membrane breaks down, becomes necrotic and leaves an ulcer which gives birth to granulation tissue. The extent of this granulation tissue depends upon the extent of the destruction of the mucosa. If the mucosa has been completely destroyed, no regeneration of epithelium is possible and the ensuing organization of the tissue results in complete obliteration. If the mucosa has not been completely destroyed, the epithelial lumen is restored, a stricture is formed, the size of which is obviously in inverse ratio to the extent of the mucosal destruction.

At the same time, the formation of new connective tissue in the muscular coats leads to two changes: (1) Deformity; (2) separation of the fibres by newly-formed connective tissue. In the peritoneal coat the formation of the new connective tissue and destruction of the surface epithelium also lead to two changes: (1) Thickening; (2) formation of adhesions. All these changes I shall demonstrate under the next heading.

Healed or Chronic Appendicitis.—Fig. 15 (2815). The lumen is small. The striking feature is the absence of the large normal crypts of the appendix. The lymphatic tissue of the appendix is sparse, as compared to the normal, while the lymph centres are entirely absent. Proceeding outward we find a very broad submucous connective tissue space, many times wider than the normal. The fibres of the muscular coats run more or less irregularly and here and there are areas of new connective tissue between the bundles. The peritoneal coat is distinctly thickened and densely fibrous.

Fig. 16 (3236). Note again the small circular cryptless lumen, and the broad submucosa which has been so greatly pulled, as it were, from the muscular layer, that a definite space has been formed. The mucosa is held to the muscular layer by few and delicate strands of connective tissue. Otherwise the same changes are present as in the previous specimen. (The blood within the lumen is the result of trauma incident to the operation.)

Fig. 17 (4456). An extremely fine lumen, surrounded by an island of mucosa and a fair amount of lymphoid tissue. Again I call attention to the broad and very attenuated submucosa. The peritoneal and muscular coats show both slight infiltration and deformity.

Obliteration.—Fig. 18 (2862). There is not the slightest trace of epithelial mucosa. The central portion of the appendix is filled by a firm fibrous tissue with many newly-formed blood-vessels. A small amount of lymphoid tissue is present near the centre of this new tissue. Proceeding outward we find a broad honeycombed submucous layer. The muscular coats are infiltrated with firm fibrous tissue; the muscle-bundles show deformity in arrangement. The peritoneal coat shows slight thickening and infiltration.

Fig. 19 (4000). The same changes as the preceding, except that the new fibrous tissue is denser, and the infiltration changes in the muscular coats are more profound. The lymphoid tissue has disappeared and almost completely. This appendix is characterized by a bulbous tip.

Fig. 20 (2820). This appendix reveals the same lesions as the previous two, except that here the broad submucosa shows extreme attenuation, as in Fig. 15.

Summary of Lesions of Chronic Appendicitis.—The histological characters of a healed or chronic appendicitis are therefore the following:

1. A narrow lumen (stricture) or
2. Complete obliteration of the lumen by new connective tissue.
3. The absence of mucosal crypts. This absence indicates, except in cases where the lumen of the appendix has been dilated from other causes (to be shown later), that a previous acute suppurative inflammation has taken place. This phenomenon is important in differential diagnosis, in cases where there is a question as to whether the lumen of the appendix is narrower than normal.
4. The widening of the submucous connective tissue zone.
5. The attenuation and diminution (or even complete disappearance) of the lymphoid tissue.
6. The infiltration of the muscular coats by new connective tissue, and consequent deformity.
7. The thickening, increased density and deformity of the peritoneal coat.

Pathogenesis.—The important point is that all these changes have not originated *de novo*, but are directly consequent on and traceable to the ravages of a previous attack. We have already seen that the primary exudate or membrane arising from the crypts destroys in part or wholly the mucosa of the appendix. We have seen, when the acute process has been arrested, how, as in all other membranous inflammations, the exudate necroses, and is cast off, leaving smaller or larger ulcers, the bases of which consist of newly-formed granulation tissue. We have also seen, in connection with the subacute forms (Fig. 10), how the uninjured epithelium regenerates and covers the adjacent ulcer. When complete healing takes place we therefore necessarily get either a stricture, the size obviously in inverse ratio to the extent of the epithelial

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destruction; or, if the destruction of the epithelium is complete, obliteration and filling up of the lumen by the newly-formed scar tissue. The destruction of the epithelium and the consequent contraction of the surrounding scar tissue obviously explain the absence of mucosal crypts.

The attenuation, diminution and occasionally even complete destruction of lymphoid tissue is due to infiltration and destruction by the purulent inflammation, described in the acute variety, and consequent replacement of the destroyed portions by newly-formed connective tissue. As I have already pointed out, the lymphatic apparatus of the appendix possesses a peculiar immunity from the destructive process, and it is unusual not to find some traces in the healed appendix.

The attenuation and increased width of the submucous connective tissue coat is due to contraction in the central area of the appendix, the result of ulceration and subsequent scar tissue formation. The width of the submucosa necessarily depends upon the extent of the central destruction. The infiltration of the muscular coats by new connective tissue and consequent deformity of the arrangement of the muscular fibres is also the direct sequel of the acute attack. The extensive early purulent inflammation disappears and is replaced, as in every purulent inflammation of other muscles, by new granulation tissue, which subsequently organizes, leaving a residuum of fibrous or scar tissue. Such fibrous tissue is found in practically every case of chronic appendicitis, and without even any other evidence is a definite sign of previous inflammation. Sometimes, however, the exudate completely absorbs and leaves so little fibrous tissue in its wake, that the muscular coats again appear practically normal. The thickening, increased density and deformity of the peritoneal coat are explainable in the same way.

Now it is entirely conceivable that if the acute process has been arrested very early, say in the stage exemplified by Fig. 2, the subsequent healing may result in a restitution to normal. I will admit that this is possible. But I have never seen any appendix that showed arrest of the process at this stage. If healing occurs, it is always at a considerably later period than this, when destruction of the mucosa has been vastly more extensive. As a result of my observations, therefore, I should say: First, *an acute appendicitis always gives rise to permanent pathological changes*; and second (a corollary of the previous statement), *a normal appendix never has been the seat of an acute attack*.

Of the diagnostic characters of healed or chronic appendicitis I lay most emphasis upon the first four, namely: (1) stricture, (2) obliteration,

tion, (3) disappearance of crypts, (4) widening of submucosa. I emphasize these because they are easily recognized by the naked eye in a cross-section of the organ. Of them all, I lay the greatest stress upon the increased widening of the submucosa, because, while one or the other of the above signs may be absent, this sign is practically constant.

I come now to a rather significant conclusion. It has been noted that in the discussion of these phases of appendicitis I use the word "healed" in addition to the label "chronic" appendicitis. I do so purposely in order to convey the firm impression that the changes I have described are not progressive or continuous, as they are in the majority of chronic inflammations within the body, but are end-products of an acute inflammation; products that forever remain quiescent unless an additional insult arises. A chronic appendicitis arising in another way than that which I have presented, I believe does not occur. I make this statement purposely rather sweeping, because some clinicians speak of a slow, progressive form of appendicitis, expressed conventionally by the term "chronic catarrhal appendicitis" or by "involution of the appendix." I am sure nothing in the appendices I have shown can in any way be covered by the term "catarrhal," a word of wide and various definition; and I am equally convinced that the changes usually associated with so-called "involution" are always the result of a previous attack or attacks, as the study of the histories of these patients has proven.

For these reasons, I hold the term "healed appendicitis" as more appropriate than "chronic appendicitis," because it conveys a closer interpretation of the process. I need hardly say that the term "healed" is used here in the pathological and not in the clinical sense.

DISEASES OF THE APPENDIX SIMULATING APPENDICITIS

Submucous Hemorrhages of the Appendix.—These are noted frequently in excised appendices, and appear as smaller or larger petechial spots scattered throughout the mucosa. In previous years this finding was sometimes viewed as a manifestation of early inflammation, but it is now generally accepted that the hemorrhages are due to operative trauma.

Fig. 21 (3688). The submucous hemorrhages are fairly extensive and involve only the portion of the mucosa between the lymph follicles. The remaining coats of the appendix are normal.

Fig. 22 (3758). The same as the preceding except that some of the hemorrhages have ruptured through the mucosa. In these appendices, the lumen will, obviously, contain fresh blood.

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Coproliths.—Fig. 23 (2776). The coprolith is represented by an amorphous mass filling the lumen of the appendix. The lumen is enormously dilated; all the coats in consequence are thin and approximated to one another. The epithelial lining is intact in places; in others it has been rubbed away. The latter finding, I have demonstrated to my satisfaction, is an artefact, due to incision of the appendix through the coprolith. If the coprolith is first gently removed, before incision of the appendix is proceeded with, the epithelial lining will be found intact as the following specimen demonstrates.

Fig. 24 (3803). Dilated appendix due to coprolith.

In both Figs. 22 and 23 there is no evidence whatever of acute or chronic inflammation.

Comment.—I fully agree with Aschoff that coproliths are not a direct cause of acute inflammation. By that I mean, that the coprolith by its irritation does not cause direct injury of the mucosa and consequent invasion by microorganisms. The reason for so believing is that I do not recall ever having seen an acute appendicitis limited to the site of the coprolith. When acute inflammations occur in appendices containing coproliths, the lesion is distal to the coprolith and involves the proximal portions only by extension. On the other hand, this observation lends support to the belief that the coprolith is probably a factor in contributing to an attack of appendicitis only in so far as it interferes with the drainage of the organ. That perforations readily occur at the site of coprolith is easily surmised from the thinness of the coats.

Lymphoid Hyperplasia of the Appendix.—Fig. 25 (3849). The diameter of the appendix is of unusual width. The mucous coat is hypertrophied, due to the enormous increase in the lymphatic tissue. The remaining coats are normal.

Comment.—Such appendices are rare and in my opinion are usually associated with a *status lymphaticus*. I infer this because at post-mortem such an hyperplasia of the lymphoid apparatus is usually found in pronounced cases of this malady. In this instance the appendix was removed from a boy seventeen years of age, who had general glandular enlargement. It is interesting to note that some authors have described these lymphoid hyperplasias as "pseudo-appendicitis lymphatica," and believe that these appendices cause pain by stretching of the coats. I am unable to vouch for the validity of this contention. The patient from whom this appendix was removed had a duodenal ulcer but there were no symptoms referable to the appendix.

Worms in the Appendix.—Fig. 26 (3121). The lumen contains numerous cross-sections of the oxyuris. These worms consist of an enveloping coat surrounding honeycombed tissue spaces, which enclose the circulatory and digestive tracts. The appendix otherwise is normal. I call special attention to the intactness of the mucosa.

Comment.—If routine examinations of appendices are made, it is surprising how frequently the oxyuris is found, especially in adults. In the past six years, I should say that I have seen this at least two dozen times. As a rule, also, the appendices have been removed in the course of operations for other intra-abdominal conditions. In some instances, the appendix was removed for pain; and in one very recent instance, the diagnosis of probable thread-worms was definitely made by my assistant, Dr. Shapiro. I conclude, therefore, that thread-worms occasionally cause pain, although this is the exception rather than the rule.

I have never seen any penetration of the tissues of the appendix by the oxyuris, although this has been described by some authors, notably by Cecil and Bulkley in this city.

Fig. 27 (3143). Appendix containing trichocephalus dispar. A cross-section of a worm is noted, partly imbedded in the mucosa and surrounded by a very thin prolongation of the adjacent epithelium. The blood in the lumen may be the result of the notorious blood sucking capabilities of this parasite; or, more probably, it is adventitious, due to trauma.

Comment.—This is the only instance of trichocephalus infection of the appendix that has come under my observation. The patient had symptoms which strongly suggested an attack of appendicitis three weeks before.

Decidua of the Appendix.—Fig. 28 (3613). This appendix was removed in the course of an operation for right-sided ectopic gestation of three months' duration. Grossly, the appendix was normal. Microscopic section shows the peritoneal coat irregularly thickened. This thickening is due to the presence of decidual cells of the classical type. The appendix otherwise is perfectly normal.

Comment.—As far as I am aware, this is the third case reported of decidual reaction in the appendix. In all three instances, there was a right-sided ectopic gestation. I have examined a dozen or more appendices removed during the course of operations for ectopic pregnancy, some even intimately adherent to the ectopic mass, but I have never since found the lesion.

This lesion is not as strange as may appear at first sight, when we consider that even in normal intra-uterine pregnancy, there is a widespread decidual reaction in the subperitoneal connective structures within the pelvis. Decidua is found not only in the mucosa of the uterus, but in the form of tubercles on the posterior aspect of the uterus, in the pouch of Douglas, and on the surface of the Fallopian tubes. I have also observed a decidual reaction on the surface of the ovary in a case

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of ovarian pregnancy. It has been found even in ovarian cysts and in intestinal adhesions, always associated, of course, with pregnancy. It might, therefore, have been predicted, that sooner or later a decidual reaction would be found in an organ so contiguous to the internal female genital organs as the appendix.

Intra-appendicular Mucocoele.—Fig. 29 (3870). Even at a superficial glance we note an unusual and profound change in the mucosa. Upon one aspect the glands are much dilated, the individual cells are greatly swollen and, what is especially striking, all have been converted into the mucous or goblet type. In the normal appendix, be it remembered, these cells are present, but in the minority. The surface epithelium, moreover, instead of being smooth, is thrown up into large villous folds. The lymphoid stroma is unusually small in amount and thin. Upon the opposite aspect of the lumen, the glands and stroma are entirely absent, so that the lumen is lined by a single layer of low cuboidal epithelium. Another striking feature is the filling up of the lumen by mucus. The epithelium lies directly against the connective tissue of the submucous coat without the interposition of lymphatic tissue. The submucosa is broad; the muscularis shows deformity and connective tissue infiltration.

Comment.—The lesion corresponds in general to that strange pathological entity, mucocoele of the appendix. The only difference is that the reported mucocoeles are much larger, often huge. Most observers agree that mucocoeles, as my specimen indicates, are sequelæ of inflammation. If these mucocoeles rupture, we may obtain that curious phenomenon, "mucoperitoneum," where the peritoneal cavity contains sometimes quarts of mucus. I do not believe that this phenomenon, which has also been described in rupture of the Fallopian tube, has ever been satisfactorily explained.

Extra-appendicular Mucocoele.—Fig. 30 (3504). Upon the peritoneal surface is a small connective tissue vesicle, lined by mucus. There is no epithelial lining. The vesicle has an intimate relation with a prolongation of connective tissue that passes through a definite hiatus in the muscular coats of the appendix; the connective tissue arises from the fibrous core of a completely obliterated appendix.

Comment.—It appears that this mucocoele has a definite relation, pathogenetically, to a previous perforation of the appendix, as evidenced by the hiatus of the muscular coats. Whether the presence of mucus is due to the remnant of a small section of prolapsed mucosa (like an implantation cyst) or to simple degeneration of the newly-formed connective tissue, I am unable to say. The second interpretation is, to my view, the more reasonable one.

Diverticulum of the Appendix.—Fig. 31 (3275). An exquisite example, where the diverticulum is nearly as large as the appendix itself. The diverticulum is formed by a prolongation of the mucosa through a distinct hiatus in the muscular

coat. The diverticulum therefore has nothing but a connective tissue and peritoneal covering. The inner surface is lined for a considerable part of its circumference by epithelium; the remainder contains a fresh exudate. The appendicular walls show evidences of acute inflammation (œdema, infiltration with polymorphonuclear leucocytes).

Fig. 32 (3304). Shows a smaller diverticulum than the preceding. The acute inflammation is more extensive and has resulted in complete destruction of the mucosa.

Comment.—Diverticulum of the appendix has come under my observation four times. In all there was an associated acute inflammation. I shall not enter into a discussion of the pathogenesis of diverticula of the intestine, because I have no definite views upon the subject. It is still a matter of controversy.

Carcinoma of the Appendix.—Fig. 33 (4670). This appendix was taken from a girl, nineteen years of age, who had suffered with pain in the right iliac region for the previous four years. A mass the size of a pea was found filling the tip of the appendix.

The tumor is a typical scirrhous carcinoma. The cells are small and polyhedral; the nuclei are small, regular and not very rich in chromatin. Note that the submucous connective tissue shows not the slightest evidence of invasion; it forms a capsule, as it were, to the tumor. The muscular coats also are normal.

Fig. 34 (3475). This appendix was removed from a man aged fifty-one, who had suffered for some months from indefinite abdominal pains. The tip of the appendix was bulbous. On section the appendix contained a large bean-shaped growth entirely obliterating the lumen.

The tumor is a typical medullary carcinoma. In contradistinction to the usual medullary carcinoma the cells are not very atypical. The nuclei are fairly uniform in size and show very few mitoses. In places we see invasion of the muscular coat by the growth. Here and there we note intact remnants of the lymphoid apparatus.

Fig. 35 (5496). Removed from a girl, fifteen years of age, during her first attack.

This specimen shows the value of routine examination of all specimens. In addition to a typical acute suppurative appendicitis, we find an area of undoubted carcinoma, involving the muscular and peritoneal coats. The structure of the carcinoma is that of the previous specimen (Fig. 34).

Fig. 36 (2582). Removed from a woman, aged thirty-five, eight years ago. The only symptom was tenderness at the site of the appendix, accompanied by alternating constipation and diarrhoea. Thus far the patient remains well.

We note a dilated lumen with intact epithelium. The lumen is filled, however, by a solid growth of typical adenocarcinoma. Inasmuch as the tumor seems to have no definite origin from the mucosa, we presume that it arose from a portion of the appendix just above or below this section. Before we could determine this, the appendix was unfortunately thrown away.

Comment.—These four appendices exemplify the predominant types of carcinoma found in the appendix. Much has been written on the

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subject, so that it will be unnecessary for me to enter into an extensive discussion. I merely desire to call attention to certain curious features of this disease. Carcinoma of the appendix differs from carcinoma of other organs and especially of the intestinal tract, in a number of features: (1) It occurs as a rule in much younger individuals; most commonly in the second and third decades. Two of our cases exemplify this. (2) Carcinomata of the appendix, both pathologically and clinically, are of a very low grade of malignancy. Appendix carcinomata resemble other carcinomata only in their alveolar structure and the epithelial type of cell. In other respects, they differ histologically from other carcinomata. The cells are smaller and less atypical; the nuclei show little variation in size and shape, are less rich in chromatin, and comparatively free from mitotic figures. Finally, there is less tendency to invasion to neighboring organic structures, and practically no tendency to metastasis. Indeed, we find these pathological data brought out by clinical experience. Carcinoma of the appendix has by far the best prognosis of any cancer in the human frame. I believe the reports of fatal cases are rare. Perhaps one of the reasons for the favorable prognosis is the early diagnosis of appendicular pain, due to the prompt interference with the drainage of the narrow lumen of the organ by the growth of the tumor. (3) The vast majority of carcinomata of the appendix is of the solid type, whereas the carcinomata of the intestine are of the glandular type.

These facts have, in times past, made me wonder whether carcinomata of the appendix are *bona fide* cancers. But after considerable study and much reflection I have not been able to arrive at any other conclusion.

CONCLUSIONS

1. The pathological lesion of acute appendicitis represents a suppurative process from the very beginning. The earliest lesion is as pathognomonic as the primary lesion of syphilis, and all the subsequent stages of the disease within the organ are directly traceable to the spread and development of this lesion. There is no pathological evidence that an "acute catarrhal" inflammation of the appendix occurs.

2. The changes associated under the name "chronic" appendicitis (stricture, obliteration, etc.) are pathogenetically the healed products of the acute lesion. According to this interpretation, chronic appendicitis is not a continuous progressive inflammation, but an end-product. There is no pathological evidence of "involution" of the appendix, or of "chronic catarrhal" inflammation of the appendix.

3. The only justifiable classification of inflammation of the appendix, therefore, is the following: (1) Acute appendicitis; (2) healing or subacute appendicitis; (3) healed or chronic appendicitis.

4. An acute localized peritonitis with the formation of fibrin and limited to the site of the lesion is always present in acute appendicitis as early as twelve hours after the onset (and perhaps earlier); so that the absence grossly of a localized peritonitis, in suspected cases, is *eo ipso* evidence of absence of acute appendicitis.

5. In addition to obliteration and stricture, attention is called to two new, easily recognizable, constant and pathognomonic signs of chronic appendicitis, namely: (1) Absence of mucosal crypts; (2) marked widening of the submucous connective tissue zone. The latter sign is especially easy to determine upon cross-section of the organ, and is recommended as the simplest way to determine the presence or absence of a chronic appendicitis.

6. Cross-section of the appendix at various levels is far preferable to longitudinal section, to determine pathological changes.

THE TREATMENT OF THE RETROCÆCAL APPENDIX

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THE difficulties encountered in the removal of a retrocæcal appendix at times transform an otherwise simple operation to one almost formidable. The incidental trauma, possible injury to the great vessels and ureter, hemorrhage and deperitonealization, coupled with the danger of rupture to the appendix or its mesentery, etc. (see Fig. 1), certainly call for operative measures more finished and more surgical *than digging it out in the blind*.

We have at our command a simple, clean, bloodless technic with which we can render the delivery of a retrocæcal appendix a finished anatomico-surgical procedure, *i.e., the mobilization of the cæcum and colon* in the conventional manner (see Figs. 4 and 5) and the freeing and delivery of the appendix under sight.

The following summary¹ shows the chief etiological factors in placing and retaining this type of appendix in its retrocæcal position, to be:

"First, the influence of peritoneal adhesions established during the descent of the cæcum from its subhepatic position to the iliac fossa.

"Second, the inherent curve of the fetal pouch.

"Third, the unequal development of the pouch."

The appendix may be found in any part of the abdomen; this is due to numerous etiological factors, more especially to conditions of arrested development of the colon. However, in this brief paper, I do not wish to confuse the issue by the injection into the subject of any of the multifold varieties of aberrant appendices, except the retrocæcal, and then only to that type of retrocæcal appendix associated with a cæcum whose descent is more or less complete, or at least in a subhepatic position (see Figs. 2 and 3). However, with a careful consideration of the relational anatomy, the suggested technic may be applied in principle to any case.

When retrocæcal, the appendix must of necessity lie to the right (external), or in rare cases, beneath (posteriorly) the mesocolon; this point is one of great importance when we come to consider the blood supply and the factors in delivery which are productive of hemorrhage.

The appendix may be primarily adherent to either the parietal

¹ Huntington: Anatomy of the Peritoneum.

peritoneum or to the posterior visceral peritoneum of the cæcum and colon and, after fusion of the parietal and visceral peritoneum occurs, it becomes hermetically sealed (see Figs. 2 and 3). Where fusion has not taken place (26 per cent. of cases) simple manual rotation of the colon inward will reveal the appendix adherent to the visceral peritoneum of the cæcum and by incising the peritoneum external and lateral to the antimesenteric border of the appendix to avoid severing vessels of the meso-appendix, it will usually free easily from its visceral attachments by dry gauze dissection from without inward.

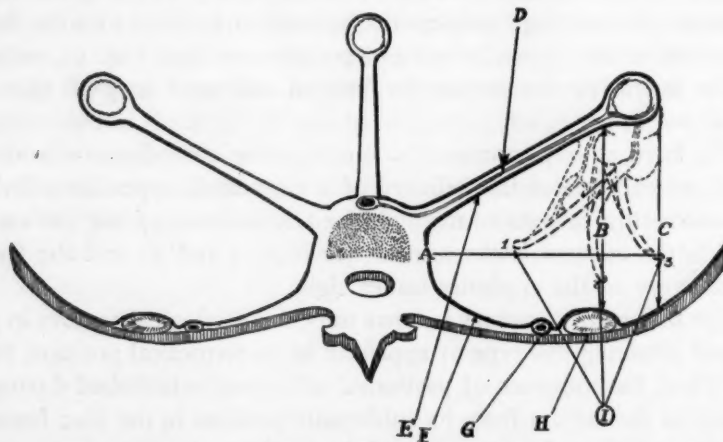


FIG. 1.—This is a schematic representation of the colon and certain structures before fusion. A to C (black line) represents the potential space between the visceral (E) and parietal (F) peritoneum before fusion, the appendix may adhere and become fixed anywhere within this space. B to C represents the retrocolic portion of the above space (*i.e.*, A to C). This is the common site of adhesions between the appendix and either the visceral or parietal peritoneum; therefore, the commonest location of the retrocaecal appendix. D, blood supply of the colon (branches of the mid-right or ilio-colic vessels) after fusion of the post layer of the mesocolon (E) with the parietal peritoneum (F). It can be readily seen how intimate the appendix must become when confined within space (A-B). E, posterior layer of the mesocolon before fusion. F, parietal peritoneum before fusion. G, ureter; always liable to positive injury in certain types of firmly fixed appendix. This could readily occur by blindly digging the appendix out, but with the cæcum mobilized the delivery of appendix by multiple ligation under sight renders such accident almost gross carelessness. H, lower portion of the kidney. I, dotted outlines 1, 2, 3 representing the appendix and its mesentery in various positions and its possible relation and directions in reference to surrounding structures as well as its own blood supply. Note how traction in certain directions must of necessity produce corresponding deformities of the cæcum and alter the direction of its longitudinal bands. By keeping this point in mind and connecting up cause and effect it will assist us materially in locating the appendix.

After removal of the same in the usual manner, colocæcopexy will perfectly peritonealize (see Fig. 5).

In that type of cases where the colon has not fused, the retrocaecal appendix is rare and, if it occurs, is generally adherent to colon and not the posterior parietes primarily (Fig. 2, C). However, a chronic appendix held in this position usually adheres more or less in time, simulating developmental fusion.

It would seem apropos to the writer to digress sufficiently at this

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point to suggest the diagnostic points necessary to determine the position of an aberrant appendix, *i.e.*, (a) careful survey of the cæcum (with the embryology thereof in mind), (b) noting the relative size and position of the terminal sacculi, (c) its topographical peritoneal relations, (d) the degree of descent, (e) its position relative to fixed landmarks,

FIG. 2.

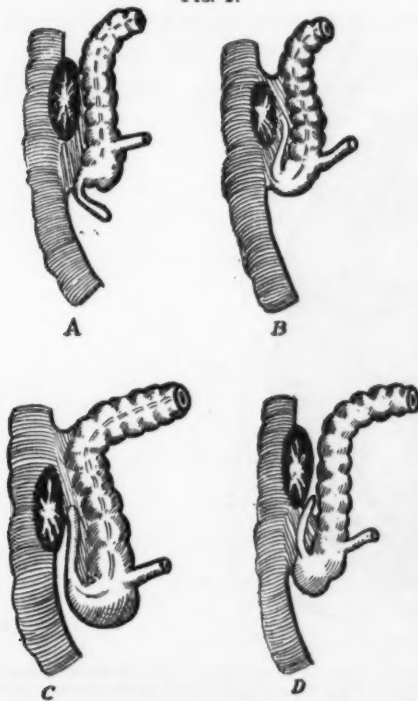


FIG. 3.

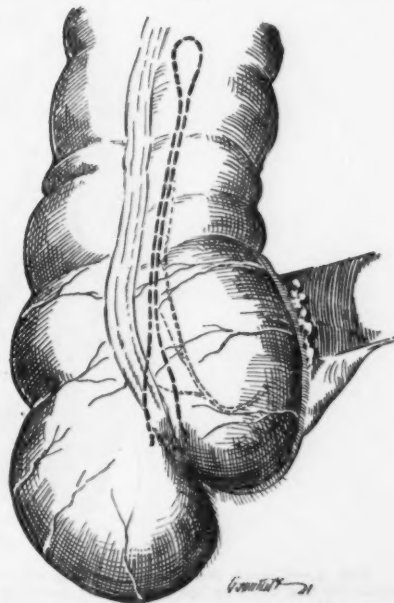


FIG. 2.—Schematic series adapted from Huntington. With the exception of the type illustrated in Fig. 3, these four types, *i.e.*, A, B, C, D, represent all of the commoner form of true retrocæcal appendix, with the peritoneal relations thereof. Notice that where fusion has taken place between parietal and visceral peritoneum (A, B, D), the cæcum fails to descend to its normal position. Where fusion fails and the appendix is simply adhered to the posterior visceral peritoneum (C) there is usually complete or exaggerated descent. In all of the above types (A, B, C, D), there is usually more or less deformity of the terminal sacculi of the cæcum.

FIG. 3.—This illustrates a type of retrocæcal appendix commonly encountered but not mentioned by Huntington. Here the weight of the descending gut evidently produces such strong traction upon the adherent appendix as to cause its marked elongation. This is often incorrectly diagnosed as the obliterative type, believing that its cord-like appearance is due to histo-pathologic changes, not taking into consideration simple elongating due to traction. (The writer has removed one specimen of this type over eleven inches in length. It had a continuous lumen through the full length of which he was able to pass a filiform bougie.) A point to be observed in this variety is the absence of any marked deformity or deviation of the cæcum, which descends practically to the normal level.

(f) associated conditions both pathological and developmental, (g) the direction of the terminal portion of the longitudinal bands, and (h) careful palpation. These are all factors of primary importance in determining the position of the appendix. (Especially practical is the pointer in reference to the direction of the longitudinal bands, see Fig. 1, I.)

By keeping in mind the etiological factors in arresting and maintaining *in situ* the retrocaecal appendix, how elementary it would seem to simply reverse the order of their occurrence (*i.e.*, first, adhesion; second, fusion) and, first, mobilize the caecum and portion of the colon necessary for exposure, then, second, under sight separate adhesions and deliver the appendix.

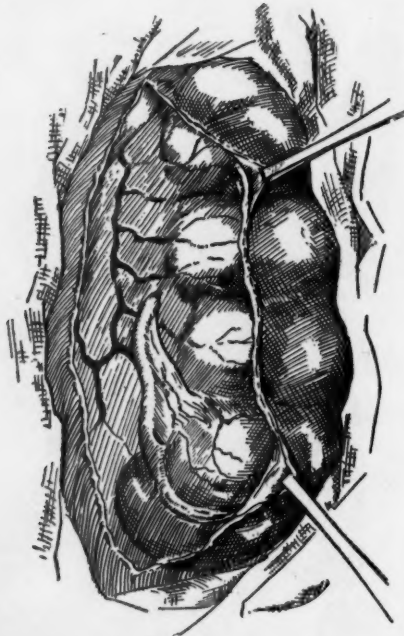


FIG. 4.—Caecum mobilized, exposing retrocaecal appendix in position. This is easily accomplished by first incising the peritoneum partially around the base of and lateral to the caecum (and colon as far as necessary) and then wiping gut from its areolar bed by simple gauze dissection. The appendix is usually more adherent to the gut than to the parietes and it is usually easier and less traumatizing to rotate the caecum with appendix intact. However, in exceptional cases where it seems to free easier from its visceral attachments, it is good technic to do so. Whichever plan is attempted, free as much colon as is necessary to ligate meso-appendix under sight, all further exposure is simply a creator of dead space and so much useless trauma. In delivering the appendix, whether attached viscally or parietally, it is well to simply ligate close to its mesenteric internal border in sections and not attempt to completely free the meso-appendix. (The meso-appendix, like all mesentery, consists of two peritoneal layers which inclose a certain amount of fat and the vascular supply, the peritoneal layers are transformed into simple areolar tissue by fusion, and therefore the only structural integrity remaining consists of vessels.)

The mobilization of the colon is a simple, clean, bloodless and accepted surgical procedure (see Figs. 4 and 5).

The delivery of the retrocaecal appendix in this manner has proven simple and logical in my hands. This method is mentioned by Vosburg² and possibly by others, and I in no sense claim it as original. However,

² Vosburg mentions this procedure in his conclusions on "Non-rotation of the Intestines." Arthur Seymour Vosburg, M.D., ANNALS OF SURGERY, vol. lviii, p. 827.

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this much is sure, that the procedure is by no means common, generally understood or adopted,³ and at the expense of reiteration I wish to adduce my personal approval, believing that the delivery of a retrocæcal appendix by mobilization of the cæcum (and colon when necessary) is certainly a distinct step in advance over the dangerous unsurgical technic of *digging them out in the blind* and will certainly bear repetition and re-emphasize a most important procedure.

Believing the subject of developmental anatomy of the gastrointestinal canal and the accepted and conventional facts in regard to

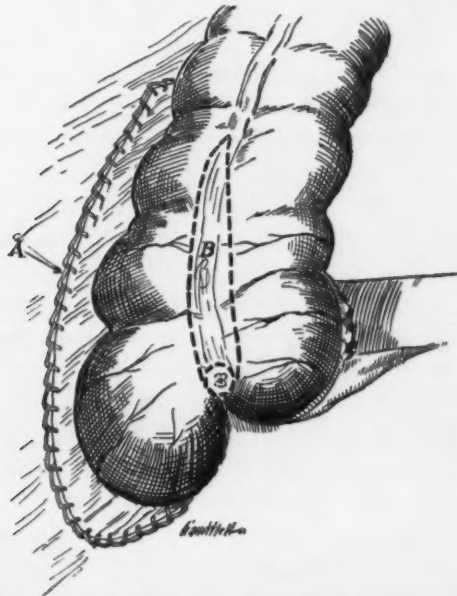


FIG. 5.—Cæcum replaced and fixed by suturing (A), which is carried partially around the base, thus beautifully peritonealizing our raw areas (B).

varieties and etiology of aberrant appendices are not proper subjects for review in current literature, I have endeavored to encroach upon the time of the reader only sufficiently to state certain basic truths, just enough to establish a rationale for the procedure advocated.

³ As a practical example of this I would suggest a glance at vol. lxiv, p. 299, Journal of the A.M.A., to an article by William Neill, Jr., entitled "Exposure of Appendix by Cullen Method." While this appears to me as a decidedly ingenious procedure (I can only speak from the grounds of theory, not practice), I would suggest a comparison of this method with the one advocated by myself, *i.e.*, mobilization, etc. The reader to judge of the relative merits. I mention this article to better emphasize the fact that this procedure (mobilization, etc.) is not in any sense common and is little understood.

HIGH INTESTINAL STASIS*

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AND

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THE problem of the cause of death in either the mechanical or functional, *i.e.*, paralytic, obstructions of the upper bowel is not a new problem of surgery. Many explanations have been offered, practically each worker offering a new theory to account for the clinical fact that such disturbances of the normal physiology of the upper bowel are marked by the clinical picture of a grave constitutional disturbance of a manifest toxic nature. Among these theories, for example, were, that the picture is due to central nervous disturbance, to peripheral nervous disturbance, *i.e.*, splanchnic paralysis,—to bacterial invasion, to a loss of a necessary function of the parts involved, to the formation of peculiar poisons, to dehydration by vomiting and diarrhoea, etc.

Instead of following the usual plan of presenting an historical summary of the subject, discussing the various theories proposed, we have thought to present a series of charts, illustrating the surgical conditions involved, in the course of the explanation of which the viewpoints of various workers will be presented.

The problem was made more concrete by the work of Draper. Draper was experimenting with a twine triangular stitch which was to take the place of the elastic ligature devised by McGraw for performing a gastro-enterostomy and was confronted with the difficulty that all his animals operated as in Fig. 1 died before 72 hours, the time which he found to be necessary for the twine stitch to cut a stoma between stomach and bowel. On the other hand, animals operated as in Fig. 2 lived, and animals operated as in Fig. 3 lived as well. In other words, animals in which a blind end of the duodenum longer than 35 cm. from the pylorus was made, lived, while if the blind end was less than 35 cm. in length measured from the pylorus, the animals died. In the first 35 cm. of the duodenum some changes therefore take place under the conditions of obstruction which cause the death of the animal. Draper's further attempts at solving the problem were directed along the line of

* Read before the Philadelphia Academy of Surgery, February 7, 1916.

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his idea that the toxin is a normal product of the duodenum, which, under normal conditions, is neutralized or detoxified by the jejunum.



FIG. 1.

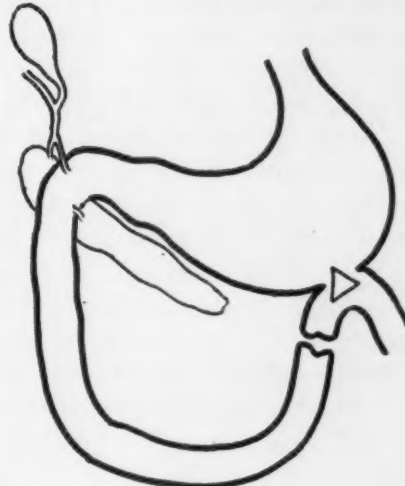


FIG. 2.



FIG. 3.



FIG. 4.

As we shall see, his idea may not be so far from the truth although his attempts to prove his point have not been convincing.

Whipple, Stone and Bernheim, of Baltimore, approached the subject by a slight modification of Draper's method, as shown in Fig. 4. To an

ordinary gastro-enterostomy is added a double ligation of the gut at the points shown. On the death of the animal this isolated loop is found to contain a powerful poison, which, free from bacteria, on injection into a normal animal will cause its death with the typical symptoms of high obstruction. This finding would seem to rule out all the other theories which do not include the action of a definite poison.

About this time we became interested in the problem, because of the possible relation to the cause of death in acute pancreatitis. It is, we believe, a generally admitted clinical fact that the symptoms of acute pancreatitis and of acute high obstruction are so alike, if not identical, that a differential diagnosis can only be made at operation. Draper had already expressed himself to the effect that the pancreatic juice, grossly at least, appears to be the lethal agent, and pointed out the technical difficulties in the way of the definite solution of this point. Certain other points needed to be cleared up, because of their bearing on general surgery, and we decided to enter the field.

The first point which interested us concerns the question, of general surgical interest, does a gastro-enterostomy opening really function in the presence of a normal pylorus? In spite of the work of Cannon and Murphy, who by their X-ray studies concluded that such an opening does not function in the presence of a normal pylorus; in spite of the work of Draper, who reported the experiment shown in Fig. 5, in which a string attached to a bolus of food shows at autopsy that it has followed the normal course of the food, there was two or three years ago but a small number of surgeons who believed that the food followed its normal course. Whipple, Stone and Bernheim seemed to take for granted that the gastro-enterostomy opening drains the stomach and upper gut, above their first ligature. It was, however, in our opinion a question whether they were not really studying a condition of functional obstruction of the upper duodenum as well as an actually obstructed portion. If such were the case, their finding of a toxin within this loop would not necessarily mean that it had been formed there; it might just as well have been formed in the functionally obstructed portion and excreted into their closed loop. The fact that they found no toxin in a closed loop the mucosa of which had been destroyed by sodium fluoride would not add further proof, for the destruction of the mucosa would destroy both possibility of formation in the loop and the possibility of excretion into the loop. We therefore tried the experiment shown in Fig. 6. If this operation be done on a series of animals, doing either the end-to-side pictured, or the ordinary lateral gastro-enterostomy, it will be found that some of the animals will die with all the symptoms of

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high obstruction; and in those that live, either an enormous dilatation of the duodenum, as shown in Fig. 7, will be found at autopsy, or perhaps less dilatation but striking hypertrophy of the muscular layers of this segment of the duodenum.

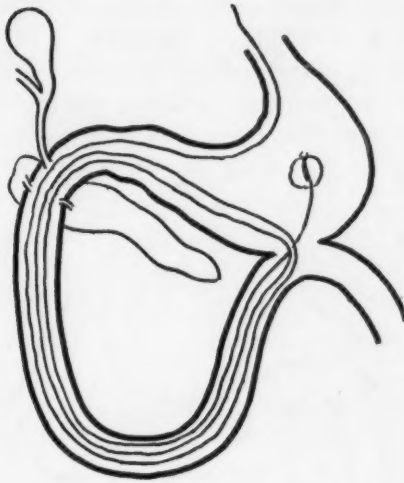


FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.

It is only this functional obstruction of this first segment of the gut, in Whipple, Stone and Bernheim's experiments, it seemed to us, which could explain the finding which they report after the operation shown in Fig. 8. They report that death follows, even though the isolated loop

be drained to the exterior, and even though it be washed out freely.

We then followed the technic shown in Fig. 9, by which, instead of doing the gastro-enterostomy with its functional obstruction, we isolate the same area of the duodenum as did they, but restore the continuity of the tract by an end-to-end suture, and we found that we could drain the loop at either end, and the animal remained perfectly well. We have had several instances in which the animal has lived for weeks with this loop closed at both ends; we have had many instances in which the animal lived for a week or ten days; we have drained into the bowel below by doing an end-to-side to a point of the bowel lower down, and



FIG. 9.



FIG. 10.

nothing happens. We find that such loops, entirely closed, tend to become enormously distended with fluid, and our present opinion is that it is only because of such distention and consequent rupture that our animals with closed loops die.

Now if a loop of the lower ileum be closed off, the continuity of the tract being restored by an end-to-end around the loop, it will be found that the animal will survive for long periods. This was shown by Halsted years ago. We have found that if we make such a low loop, and fill it with pancreatic juice, or with a fresh dog's pancreas, the animal may die in the time limit, and with the symptoms, characteristic of high obstruction. But this experiment is not conclusive of the rôle

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of the pancreas or its ferments in the production of the poison in question, for we may have added only the necessary pabulum for the intestinal bacteria. Let us look for a moment at the chart Fig. 12, which shows the toxic products of proteid digestion. Highly toxic properties have been found in the proteose stage of protein digestion. The normal ferments of the stomach and the normal ferments of the pancreas can, of course, break a protein down to this stage; normally it is supposed that the gastric digestion carries the proteins of the food to the peptone stage, from which the digestion is carried to the amino-acid stage by the ferments of the pancreas and the intestine. The intestinal juice is not supposed to contain any proteolytic ferment except the ferment erepsin, which can digest the protein casein, but no others, while its chief function is to digest the proteoses to the amino-acids. But either gastric or pancreatic ferment is capable of producing a toxic proteose. In addition, many bacteria can digest the protein building-stones to the highly toxic amine compounds. Further, the substance lecithin can, by the action of the fat-splitting ferment lipase, be broken down with the formation of the choline bases, some of which, such as choline and neurine, are highly toxic.

Whipple and his associates have recently published their work, which proves that the toxic body found in their high loops is a proteose, and they have further shown that this purified proteose will exactly reproduce the symptoms of high obstruction when injected into a normal animal. This is a very different demonstration from the work of Murphy, of St. Louis, who found that the material from a loop of intestine which had been permitted to "autolyze," *sic* putrefy, in the incubator for some weeks, or that the material from an infected gall-bladder, is toxic. Only the isolation of the poison and the proof that it reproduces the symptoms of the condition we are studying will prove anything.

Now Whipple's demonstration that the toxin involved is a proteose makes it still more difficult to understand his previous contentions that this toxin is formed in the intestinal loop, or by the mucosa of the intestinal loop. For the formation of a proteose a proteolytic ferment is essential, and the mucosa is not supposed to contain any proteolytic ferment except the ferment erepsin, which is supposed to break down, not form, the proteoses. We have found this proteose in our own loops in animals operated as in Fig. 9, and, nevertheless, we are not prepared to admit that this toxin can be formed without the assistance of the pancreatic juice.

We are inclined to rule out the gastric digestion because of the experiment shown in Fig. 11. In an animal in which, a long time pre-

vious, the ducts of the pancreas have been tied, so that for a long period no pancreatic ferments have been entering the intestine, an absolute high obstruction, without the formation of any loops, was produced. Three such animals have lived for seven and eight days, instead of the two to three days a normal animal will live with such an obstruction. Further, we have obtained a toxic material from loops of intestine in such animals which had no external secretion of their pancreas, but it was not a proteose. From the symptoms produced it would seem that this poison belonged in the class of the choline bases. The intestinal juice, while it contains no proteolytic ferment capable of producing a



FIG. 11.

proteose, does contain a lipase. An animal in which the operation shown in Fig. 11 has been done should have the products of gastric digestion, which products might contain a proteose, but the fact that they do not die with the symptoms of high obstruction leads us to rule out the stomach.

Two findings in the course of this work have, therefore, interested us surgically. First, the added demonstration of the fact that a gastro-enterostomy opening does not function in the presence of a normal pylorus. The second, the explanation of the similarity between acute pancreatitis and acute high obstruction,—they are alike because they are both essentially the same thing, an intoxication with the toxic products of protein cleavage, in pancreatitis certainly due to the proteolytic

HIGH INTESTINAL STASIS

ferment of the pancreas, in high obstruction not necessarily, perhaps, but in our opinion in all probability, the same toxin, produced by the same ferment. In pancreatitis the escape of the products of the digestion of the pancreas into the tissues permits the intoxication; in obstruction the conditions of obstruction permit the absorption of toxic products, which under normal conditions would either not be formed, or if formed would be immediately broken down to non-toxic products.

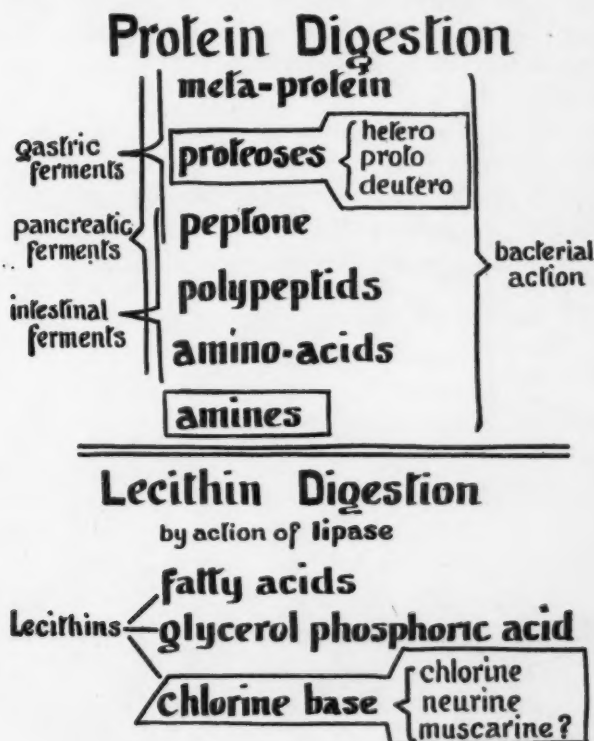


FIG. 12.

Draper's idea that we are dealing with a normal product of the duodenum which in normal conditions is detoxified by the jejunum may be not so far wrong after all.

There is another phase of this problem which we think may have surgical interest and importance. The work which has been done on stasis in the large intestine has all suffered from the fact that no one has ever been able to actually demonstrate any definite poison. Drs. Frazier and Peet have just recounted their failure to find any such toxin; Strauss has recently reported experiments in which he demonstrated

that segments of the colon can be indefinitely isolated. The old experiments of Halsted show that chronic ileal stasis can be indefinitely borne. Are we, perhaps, looking at the wrong end of the intestinal tract, even in these cases? The ptosis of the colon will certainly drag the head of the pancreas across the transverse duodenum, and, indeed, a dilated duodenum has often been reported in these cases. The removal of the colon would relieve this drag. In other words, given the demonstration of a toxin of great potentiality—less than one-tenth of a gramme of this proteose will kill a 15-pound dog in a few hours—would it not be well for the clinician to consider the possibilities of a chronic absorption of such a poison?

We are aware that surgery already possesses a plethora of theories; but as long as a theory is given its proper evaluation as a theory, as a working hypothesis, and is not accepted until supported by such an array of facts that the theory has itself become a fact, these theories offer the only means of progress in a field where so little is known.

EXPERIMENTAL COLONIC STASIS

BY CHARLES H. FRAZIER, M.D.

AND

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It is a well recognized fact that more putrefaction takes place in the colon than in any other part of the gastro-enteric system, largely due to the normal stasis in this organ, but since so much attention has recently been directed to the possible absorption of large quantities of putrefactive toxins from abnormal stasis, it was considered advisable to produce experimentally such a condition and to determine by accurate chemical analyses the toxic substances eliminated by the urine.

Since the dog possesses practically a straight colon, it was evident that the maximum amount of stasis without partial obstruction could be secured by a simple reversal of the large intestine, which for some time at least should give a reversed peristalsis, *i.e.*, away from the anus instead of towards it.

The possible action of the liver in removing, before they could be excreted by the kidneys, appreciable quantities of the absorbed products of intestinal putrefaction was determined by the production of an Eck fistula with ligation of the portal vein above the venous anastomosis.

Technic of Colonic Reversal.—Medium-sized female dogs were used. Under ether anæsthesia, a low midline incision was made. A section of colon above the sigmoid varying in length from four to six inches was selected, divided at either end between clamps, reversed, and end-to-end anastomosis performed, silk or chromic catgut being used for the interrupted approximating sutures and silk for the continuous Cushing right-angled suture. The abdominal wound was closed with silk. Recovery was rapid and the post-operative history was satisfactory.

In a few dogs some dilatation of the reversed colon was found at autopsy. This was invariably due to partial obstruction from stenosis at the lower anastomosis. In no case did this added stasis make an appreciable difference in the results.

Technic of Eck Fistula.—Under ether anæsthesia, a midline incision, extending from a little below the ensiform cartilage to the umbilicus, was made. In the first two operations, we followed the technic of

Carrel and Guthrie, the vena cava and portal vein being isolated and their lumen closed by taps or serrefines. Later, a special spring-jawed forceps with curved blades, resembling a diminutive intestinal clamp, was used. We found this greatly facilitated the operation since it entirely did away with the isolation of the vessels. The clamp was placed lengthwise on the vessel and afforded ample room for the anastomosis. The suture technic of Carrel and Guthrie was adhered to with the exception of the needles used. We found by shortening and curving the Kirby No. 16 needles that the stitches could be more easily placed. Paraffin oil was used to prevent clotting. At the completion of the venous anastomosis, a heavy silk ligature was tied around the portal vein close to its entrance into the liver, thus forcing all of the portal circulation directly into the vena cava. The recovery was usually rapid and uneventful.

Results of Reversal of the Colon.—In some dogs, immediately following operation the stools were very soft, but as a rule they were well formed and did not differ in gross appearance from those passed before operation. Practically all the dogs gained weight after a few weeks, although a loss in weight generally occurred at first. One dog weighed nearly twice as much thirteen months after colonic reversal as at time of operation.

Urinary Findings After Reversal of the Colon.—The report of the chemical investigation made by Dr. A. E. Taylor is as follows: Chemical analyses of the urine showed an excess of the urinary bases. These excesses were only marked for a short time following the operation. Later there was little evidence of any excess.

The following substances were demonstrated by qualitative tests: Methylamine, trimethylamine, tetramethylendiamine, pentamethylendiamine, paroxyphenylethylamine. From the presence of the last, we may reasonably infer the presence of phenylethylamine. Methylguanidine, diamethylguanidine, and imidazolethylamine were searched for in vain.

The finding of these substances can be reasonably interpreted as the result of simple but excessive putrefaction of protein and amino-acids in the colon. Apparently the direction of these processes of putrefaction was not abnormal in the qualitative sense, but only in the quantitative.

The urine of these dogs as well as the substances obtained after chemical isolation of the mixed bases was injected intravenously, but no noticeable toxicity could be established nor did the curve of blood-pressure differ from that to be noted following the injection of normal canine urine.

EXPERIMENTAL COLONIC STASIS

Results Following Reversal of the Colon in Dogs with an Eck Fistula.—The dogs with Eck fistula differed in no way from those with simple reversal of the colon. The stools were well formed, the animals ate well, and no toxic symptoms were demonstrable. The chemical analysis of the urine was the same as before, both qualitatively and quantitatively, showing that the liver had not removed or changed the substance absorbed from the colon.

Conclusion.—The results of these experiments would seem to indicate that mere stagnation of fæces in the colon of the dog, when on a normal mixed diet, does not lead to the formation of toxic substances of note, at least in the presence of the normal flora of the canine colon.

The fact that these dogs remained in perfect health and gained in weight would indicate that simple colonic stasis in the dog is harmless and certainly would suggest that the dire effects attributed to colonic stasis in man were, in part at least, due to some other cause than the absorption of the products usually formed in simple fecal stagnation.

JEJUNAL ULCER, FOLLOWING GASTRO-ENTEROSTOMY FOR DUODENAL ULCER, WITH COMPLETE CLOSURE OF THE GASTRIC END OF THE STOMA *

BY NATHANIEL GINSBURG, M.D.
OF PHILADELPHIA, PA.

THE subject of this communication is the history of a case of jejunal ulcer occurring in an adult male, two and a half years after the performance of a posterior gastrojejunostomy for a duodenal ulcer, correctly diagnosed, and properly treated. The occurrence of a jejunal ulcer in this case following gastro-enterostomy is not regarded as particularly unique in any sense, but the absolute closure of the stoma discovered by radiologic examination, and later confirmed by operative exploration, coexistent with a large jejunal ulcer at the duodenojejunal angle, is deemed a surgical post-operative state worthy of report and record.

While gastrojejunal and jejunal ulcer as a sequence of gastrojejunostomy have been observed in considerably over a hundred cases, the complete closure of the orifice in the presence of ulcer, as far as the search of the literature reveals, was present in only two other instances. The report of this case, therefore, makes three occurrences of gastrojejunal or jejunal ulcer accompanying absolute closure of the stoma created by the first operation.¹

The patient is fifty-one years of age, and has been a cabinet-maker by trade. His occupation has exposed his epigastric triangle to constant traumatism from the pressure of tools in this region. In May, 1912, he was submitted to an operation for duodenal ulcer by another surgeon, a posterior gastrojejunostomy having been performed. His symptoms before this operation were indigestion, post-ingestion vomiting of food, epigastric pain, and loss of weight. The pain occurred one to three hours after taking food. His vomitus did not contain blood at any time, nor was blood ever noted in his stools.

The patient consulted me at the suggestion of Dr. L. H. Jacob, on October 16, 1915, complaining of pain and soreness in the upper abdomen, loss of appetite, vomiting, and gradual and persistent decrease in weight. He was markedly constipated, requiring salts for relief. His pain was relieved by food ingestion, but returned

* Read before the Philadelphia Academy of Surgery, February 7, 1916.

¹ Hartman reports 7 cases of obliteration of the gastro-enterostomy stoma due to cicatrization of secondary gastrojejunal ulcer (ANN OF SURG., June, 1914).

JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

some hours later. There was no nocturnal pain or hunger during the week previous to the date I first observed him. He had had eructations of food and gas, lately with daily vomiting after his evening meal. He regarded his condition as rapidly progressive, having lost thirty pounds.

The physical examination of the patient was negative, except for the right rectus scar of the previous operation and marked epigastric rigidity, with tenderness on deep pressure. Radiographic examination of the stomach revealed no indication of the gastrojejunal orifice, and no evidence of pyloric or duodenal blockade. The gastric outline did not suggest gross morphologic disturbance in this organ, and a test-meal did not support retention, since recovery of any portion of the ingesta was not obtained six hours later.

On October 21, 1915, exploration of the upper abdomen through a right rectus incision revealed extensive perigastric and pericolic adhesions to the liver, gall-bladder, and parietal peritoneum. The gall-bladder was easily compressed, and free of stones or gross mural change. Inspection of the duodenum revealed a small stellate scar on the ventrolateral surface of bowel, two inches from the pylorus, the remains of a healed ulcer. There was very slight induration at this point, and no duodenal closure existed, nor was there evidence pointing to previous surgical interference with the bowel lumen proximal to the ulcer. The stomach was mobilized, and inspection of the gastrojejunal site revealed the presence of an annular, circumscribed area about the size of a half-dollar, corresponding to the location of the previously existing communication between the small bowel and the stomach. Invagination was impossible, and apparently no opening existed between the stomach and the intestine. The root of the mesentery contained several large lymph-nodes adjacent to the indurated area.

Separation of the two structures at the gastrojejunal site brought to view a large indurated, excavated ulcer in the jejunum, at the duodenojejunal angle, the base of the ulcer being formed by the gastric wall, and occupying a superior position in the small intestine. The lesion corresponded to the site of the anastomosis. No shreds of suture material were found hanging from the margin, or were discovered embedded in the ulcer tissue. Excision of the ulcer was performed, and the large opening in the jejunum was closed by reversing the axis of the opening by transverse suture of the bowel wound with chromic catgut. Closure of the small intestine was exceedingly difficult, owing to the immobility of the terminal limb of the duodenum lying on the ventral surface of the vertebral column. Interrupted catgut sutures were employed, suspending the intestine from the inferior border of the pancreas

to reinforce those first introduced. The lumen of the bowel after closure was not encroached upon sufficiently to jeopardize its patency at this point. Digital exploration through the opening in the posterior wall of the stomach failed to find any communication between this organ and the bowel. The gastric opening was closed by inversion with catgut, reinforced by seromuscular sutures of silk.

The patient made a rapid and satisfactory recovery from the operation, requiring repeated lavage only during the first twenty-four hours. He has lived upon a carefully restricted diet until within the past few weeks. At present he is well and suffering no gastric disturbance.

Jejunal ulcer and gastrojejunal ulcer as a sequence of gastro-enterostomy have been noted with increasing frequency during the past five years, and the number of recorded cases supported by operative discovery is reaching a considerable size. Schostak, von Eiselsberg, Roojen, Moynihan, Mayo, Patterson, Lieblein and others have called attention to this subject in written communications, and have operated for the removal of this offending feature in the physiologic success of the previously performed gastro-intestinal anastomosis. American medical literature contains but few references to this condition, and those which have appeared are but brief case reports; largely emanating from a single surgical clinic in this country (see Mayo Clinic Reports). Patterson, of London, has contributed the most exhaustive review of the subject of gastrojejunal and jejunal ulcer to be found in the English language. His paper was preceded by a notable study of the subject by Schostak, who with Lieblein has offered the best reports from the continental surgical clinics. Lieblein's paper is a carefully written and exhaustive compilation of all the cases thus far reported in the literature, and pays much attention to the factors relating to the etiologic causes and prevention of this unfortunate operative sequence.

Wolfler first called attention to this condition in 1881; but it was not until 1899 that Braun reported the first case of ulcer of this type before the German Surgical Congress, after having verified at autopsy a perforated jejunal ulcer which followed posterior gastro-enterostomy performed eleven months previously. In 1902, Quènu reported the first case in England. In 1907, Hamann published in the *Cleveland Medical Journal* the first case of perforated jejunal ulcer recorded in America. In 1907, Schostak exhaustively considered 35 cases of ulcer of this type. In 1909, Herbert Patterson, of London, collected 52 cases, and, in 1910, Roojen reviewed 78 cases. Lieblein has collected 129 cases up to the date of his publication (June, 1915), 79 being jejunal ulcers and 50 gastro-

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jejunal in type. All these cases were verified by operation or autopsy.

The ulcers, either gastrojejunal or jejunal in type, have been single as a rule, although one case of multiple ulcers of the jejunum occurred in the practice of Lennander following gastro-enterostomy performed for carcinoma of the stomach. At autopsy, the patient having died on the tenth day from peritonitis, the presence of these ulcers was confirmed.

This lesion is distinctly a sequence of gastrojejunostomy performed for the relief of a gastric or duodenal ulcer, and has been reported more frequently in cases following an anterior gastro-enterostomy than after the operation by the posterior route. Fifty-two carefully studied cases were associated with anterior gastro-enterostomy and 25 cases followed the posterior operation.

The frequency with which this type of ulcer has been known to follow gastro-enterostomy for the relief of gastric or duodenal ulcer is difficult of correct estimation. Patterson regarded the occurrence as being 2 per cent., but this percentage is largely conjectural and open to serious question, owing to the fact that his statistics are entirely based upon reports collected from European sources. He excluded in his estimation a great number of operations performed in this country, following which ulcer of this type has not been reported. Since many thousands of patients have been operated upon for gastric and duodenal ulcer in America with relatively few cases of gastrojejunal or jejunal ulcer complicating the post-operative state, it is obvious that no correct estimation of the frequency of this type of ulcer is possible at the present time. This is explained by the fact that highly developed and skilful gastro-intestinal surgery in this country has eliminated the possibility of the frequent occurrence of this complication.

Etiology.—The etiological factors underlying the development of gastrojejunal and jejunal ulcer are numerous and no single element should be regarded as being the causative agent.

So far as the writer has been able to discover, there is no detailed report with relation to post-operative gastric analyses in cases in which gastrojejunostomy had been done for gastric or duodenal ulcer. No doubt much interest would attach to careful systematic studies of a series of cases operated upon, in which ulcer was found at operation. Relief of symptoms occurring in about 85 per cent. of cases following gastrojejunostomy is in itself evidence of the curative value of the operation. However, the 15 per cent. of cases somewhat bettered or not helped by the operation would make an exceedingly interesting subject for future contemplation. Patterson is one of the few who

appears to have systematically studied gastric contents before and after operation, and he has shown that hyperacidity following gastrojejunostomy may occur.

Early closure of the gastrojejunal stoma due to cicatrization, with or without the presence of gastrojejunal ulcer, may occur if the pylorus is patent, and no doubt in these cases future studies will reveal marked hyperacidity of the gastric contents.

W. J. Mayo agrees with Patterson that gastrojejunal ulcers are the result of technical failures in the performance of the operation (gastrojejunostomy), and differ from true jejunal ulcers, which he regards as the result of alterations in the normal physiologic intestinal conditions. In the latter case, the jejunum, which has been constantly bathed in the alkaline pancreatic and biliary secretions, is suddenly subjected to a hyperacid gastric secretion, and therefore loses the surface protection which is present before gastro-enterostomy is performed. In other words, the mucous membrane through a long period of evolution is abruptly transferred into an acid atmosphere after having been subjected to the environment of a constant alkaline secretion. Jejunal ulcer can occur, however, independent of any operative procedure, and give rise to perforation, as proven by the following case.

Francis O. Simpson, of the West Riding Asylum, Wakefield, England, reported a case of acute perforated jejunal ulcer in a man fifty-six years of age, who died, and in whom at autopsy a perforation of a jejunal ulcer about six centimetres from the duodenojejunal angle was found. This case has an interesting bearing upon the etiology of jejunal ulcer, since it is reasonable to assume that, if hyperacidity plays some part in the production of gastric or duodenal ulcer, it may, by creating an upper jejunal acidity, predispose to the development of jejunal ulcer.

The toxic action of the hyperacid gastric juice upon the cells of the mucous membrane causes protoplasmic destruction, the act of digestion being completed by the intestinal juices. This single agent associated with the traumatism to the mucous membrane of the jejunum, incident to the application of an intestinal clamp for the performance of gastro-enterostomy, must in itself be regarded as an important causative element. When the ulcer exists at the site of the anastomosis and is, therefore, gastrojejunal in type, there is no doubt but that the gastric hypersecretion and the wound made in effecting the anastomosis are the two factors largely responsible for this lesion. There is much discussion as to whether the mucous membrane at the suture line heals by primary or secondary intention, and of the relationship the suture material

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employed in making the anastomosis bears to the development of ulcer in the margin of the stoma. There is no doubt in the writer's mind, from a careful study of the subject, that the suture line does not heal by primary intention, and that the catgut employed on the mucous surface produces necrosis, and is either absorbed or thrown off, causing the stoma to reach to the seromuscular suture line. It is, therefore, obvious that healing takes place at the gastro-enterostomy orifices by primarily producing an annular granulating surface which quickly heals over and extends down to the seromuscular suture line. The toxic and digestive action of the gastric and duodenal juices upon an unhealed surface, over a long or short period of time, render possible the development of an ulcer. When the seromuscular suture line is made with a continuous strand of silk or linen, it has not been infrequently the experience at operation to find shreds of this material hanging in the orifice from the margin of the stoma. This foreign unabsorbable material acts as a "septic drain," retarding healing and maintaining constant irritation. Since, however, many cases are on record in which no suture material was found in the ulcer at operation, we must conclude that the use of an unabsorbable suture with danger of the shred becoming part of the gastro-enterostomy orifice, while an important contributing factor, is not the sole causative agent in the production of this pathological state. A continuous seromuscular suture may narrow the newly created opening by having a tendency to purse-string the gastro-enterostomy orifice, and this important agency in the production of ulcer at the anastomosis site must not be overlooked.

No doubt, after gastro-enterostomy for gastric or duodenal ulcer, hyperacidity in most cases is quickly relieved. There are cases, however, in which the hyperacidity persists for some time following the operation, and, when associated with indiscretion in diet, we have important predisposing factors in the development of gastrojejunal or jejunal ulcer. What relationship patency of the pylorus bears to the production of this type of ulcer we are unable to say, since closure of the pylorus forces the gastric contents to pass through the newly acquired opening in the stomach wall, while on the other hand there are those who maintain that pyloric or duodenal exclusion is unnecessary to the physiologic success of the operation, and therefore do not practise this procedure.

The studies of Rosenow have thrown so much light upon the agency of infection (*streptococcus*) as an important factor in the development of gastric and intestinal ulcer, that the evidence adduced by him cannot be disregarded in a discussion of the causation of this condition. In the

case of the types of ulcer under consideration, the ideal conditions exist for implantation of organisms upon a traumatized surface, in which circulatory interference has taken place from the application of clamps or as the result of suturing.

It should be noted that Patterson, in his very complete discussion of this subject, first insisted upon the classification of ulcers into two groups—(1) gastrojejunal and (2) jejunal ulcers—depending upon the location of the ulcer with reference to the anastomosis previously made and the etiologic factors relating to their origin.

In the first group, the ulcer is part of the stoma, developing on the suture line, and possesses the real causative elements, viz.: the open wound of the gastric and jejunal mucosa, plus the importance of the unabsorbed silk or linen suture and the hyperacid gastric secretion. In the second group of cases (jejunal ulcer), the important factor in the ulcer production is undoubtedly the contact of an acid secretion on a mucous surface, constantly bathed by an alkaline medium.

Diagnosis.—When symptoms suggestive of the primary lesion occur a year or more after a period of complete relief, and strongly suggest recurrent pathological activity of the gastric or duodenal ulcer previously operated upon, the clinical evidence should strongly suggest the possibility of a gastrojejunal or jejunal ulcer rather than a recrudescence of an ulcer which has probably healed following the operation. It is evident that the diagnosis of this unusual lesion, even when based upon clinical evidence of undoubted importance pointing to the primary lesion, can only be certified by operation and an examination of the gastro-enterostomatized site.

Since an abdominal tumor has been present close to the midline in the epigastrium in many of the cases, this evidence, supported by the clinical features of the case, is of much value in arriving at a correct conclusion. The tumefaction, however, has been frequently mistaken for some other epigastric lesion, and ulcer was not considered. In the future, careful and repeated gastric analyses indicating hyperacidity will be an important factor pointing to the presence of ulcer.

Radiologic studies of the stoma of gastro-enterostomatized patients have only recently been made for the purpose of diagnosing the presence of gastrojejunal ulcer. Carman and Balfour have recently summarized their studies of eleven patients examined by means of the Röntgen ray. They observed that ten patients showed abnormalities not customarily seen. The signs usually found were retention from a six-hour meal, large size of the stomach, exaggerated peristalsis and spasticity, and deformity of contour about the stoma. There was local irregularity of

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the jejunal contour, and some dilatation of the duodenum was also present. They regard marked deformity about the stoma as the most suggestive feature of gastrojejunal ulcer if associated with clinical evidence suggestive of the presence of this lesion.

Clinically there are two types of cases:

(1) In this class of cases the first symptoms immediately suggest an acute perforation of either the stomach or the duodenum, and the symptom-complex is characteristic of this grave abdominal catastrophe. Sudden, sharp, agonizing upper abdominal pain, accompanied by evidence of severe shock, with early board-like rigidity of the abdominal wall and a scaphoid abdomen, leaves no doubt in the observer's mind of the evidence of perforation. The pulse, during the first hours following perforation, is slow and full, and nausea and vomiting accompany the symptoms enumerated. The pain is intense and continuous, and little relief is afforded by the administration of morphine. The rigidity is often maintained even in the presence of deep ether narcosis. The absolute localization of the lesion in this class of cases can only be determined by immediate exploration, which should be the rule.

(2) In the group of cases where chronicity of symptoms is attended by the formation of protective adhesions about the ulcer site, acute perforation into the abdominal cavity does not occur. Tumor formation about the ulcer site may occur with adhesion to the anterior abdominal wall, stomach, colon, or small intestine, resulting in perforation and the establishment of a fistula into one of these structures. In one of Patterson's cases perforation took place into the anterior abdominal wall, and resulted in a jejunal fistula discharging on the surface of the abdomen. It is not unusual, from a survey of the cases reported, to find instances of perforation of the ulcer into the colon or small intestine. In the latter class of cases, radiographic examination, employing bismuth, will assist in clearing up the diagnosis.

In spite, however, of these various symptoms, the cases which have come to operation in this country have largely been patients in whom the clinical evidence of renewed activity of the primary lesion was suspected, and the pathology present was ascertained only by surgical operation.

Treatment.—The treatment of acute perforating ulcer of any abdominal hollow viscus is immediate operation, and the application of measures best adapted to the case in question. Closure of the ulcer is of greatest importance, and any other procedure will depend upon the conditions present. Dissociation of the gastro-enterostomy previously made may be all that is necessary combined with careful closure of the

openings in the stomach and intestine. This was practised in the writer's case (not acute perforation), and, since the primary duodenal ulcer had completely healed, there was no reason for performing a new gastro-enterostomy. The earlier cases reported, in which ulcer followed anterior gastrojejunostomy, presented a number of complications, such as fistula into adjacent organs or into the abdominal wall, and the surgical requirements were more extensive than they have been in ulcers latterly seen, especially in this country.

The necessity for suprapubic drainage following acute perforation will largely depend upon the amount of foreign material found in the abdomen at operation, and the time elapsing between perforation and exploration. When there is much soiling of the abdomen and beginning peritonitis is present, drainage should always be instituted. It should be the rule, however, in operating upon these cases to do as little as possible, since the separation of protective adhesions may open new avenues of infection, and disseminate foci which have been well localized and restricted by nature. Mayo, in a number of cases, has excised the ulcer and closed the gastric and jejunal openings, performing a new gastrojejunostomy when it has been deemed necessary.

Many cases, not acute in nature, which have come to operation have been those in which gastroenterostomy was done one to three years previously (some cases exceeding this period of time), and the primary lesion, either gastric or duodenal, has been found to have healed, and therefore the measures have been largely directed toward the relief of the symptoms produced by the complication at the gastro-enterostomy site. Closure of the jejunum, if the anastomosis has been made close to the ligament of Treitz, may be an extremely difficult procedure, since the distal limb of the duodenum, lying retroperitoneal and being immobile, cannot be delivered into the wound. Suture of the bowel should be either oblique or transverse with relation to its longitudinal axis, and every effort should be made to prevent narrowing of its lumen. Catgut should be employed and, if necessary, reinforced by interrupted seromuscular sutures of silk or linen. The latter should not penetrate the mucous surface of the bowel.

The prophylaxis of this condition entails the careful scrutiny of every patient's diet following the performance of gastro-enterostomy for gastric or duodenal ulcer. The immediate transformation from a long period of illness, occasioned by the ulcer present, into perfect health does not occur; and the digestive apparatus should not be subjected to unnecessary tests too soon. The administration of alkalies to overcome any hyperacidity remaining after the operation is advisable,

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and careful selection of articles of diet is likewise of much importance. Patterson is so strongly imbued with the importance of dietetic observation in his patients who have been gastro-enterostomatized for ulcer of the stomach or duodenum, that he does not advise meat as part of the diet for six months following operation. Small quantities of food at frequent intervals have a better physiologic effect upon the recently short-circuited stomach than three regular meals daily, consisting of an unlimited selection and quantity.

Since no cases of gastrojejunal or jejunal ulcer have been known to follow the pyloroplastic operation as devised and performed by Finney, this operation should have first place when it is indicated in the treatment of pyloric ulcer. The posterior no-loop gastrojejunosomy as performed in this country has shown fewer ulcers than any other operation save the Finney type. Theoretically, the performance of gastro-enterostomy without the use of clamps, thereby not traumatizing the mucosa of either the stomach or the jejunum, possesses more safety than the operation in which either the single or paired clamps are employed for holding the two structures in apposition. Interrupted seromuscular sutures of silk, linen, or catgut are preferable to the continuous suture which may persist, hanging in the stoma created. There are some surgeons who regard the suture element in the production of gastrojejunal ulcer of so much importance that they employ only catgut for all suturing in this operation. A large opening and either permanent or temporary blockade of the duodenum are of much importance in safeguarding against the development of ulcer at the stoma. At the present time, the question of duodenal closure by ligature, or unilateral exclusion, as practised by von Eiselsberg, is still a debatable question, if one may judge by the literature available upon this subject.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting, held February 9, 1916

The President, DR. CHAS. N. DOWD, in the Chair

SYPHILIS OF THE STOMACH—PYLORECTOMY

DR. JOHN DOUGLAS presented a man, aged sixty-five years, who had suffered from indigestion since he was twenty years old, associated with severe attacks of pain in stomach, irrespective of meals, for nine years. Pain so severe he could not sleep. Always worse when stomach was empty. Vomited frequently. Attacks of severe cramp-like pains occurred at any time during day, causing vomiting. Frequently vomited large quantities of blood, sometimes more than a litre. Had a large hemorrhage just before entering hospital. Had lost a great deal of flesh and strength and appears cachectic. Radiographic examination shows filling defect of lesser curvature and large residue. Diagnosis of carcinoma made from radiograph. Gastric analysis showed no free HCl and presence of lactic acid. Wassermann 14-unit positive, although no history of syphilis could be obtained.

Patient was kept on antiluetic treatment with salvarsan and Hg injection for twenty-four days; then, as pain continued, and on account of his age, and symptoms pointing to the possibility of carcinoma developing on the base of a luetic ulcer, as is known happens in the tongue and other regions, operation was performed.

Pathological Findings.—Two small ulcers, one a little more, the other somewhat less, than 1 cm. in diameter, found on the anterior wall of the pyloric portion of the stomach, near the lesser curvature, surrounded by an area of induration, involving most of the anterior wall of the pyloric portion of the stomach.

Operative Procedure.—Bellevue Hospital, July 30, 1915. Pylorectomy by the Billroth No. 2 method.

Pathological examination showed no evidence of carcinoma. Convalescence was uneventful and at present, six months after operation, has no stomach symptoms and has gained forty-one pounds in weight since leaving the hospital.

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GASTRIC ULCER—EXCISION

DR. DOUGLAS presented a man aged fifty-two, who for four years had suffered from severe pain in the left epigastrium, spreading into the back, two or three hours after eating. Never vomited or conscious of sour stomach. Pain at first relieved by soda bicarb., later not. Never had night pains or hunger pains and felt better when lying down. Not very constipated, but occasionally took laxatives. Radiographic examination, negative, except for six-hour residue. Gastric analysis showed free HCl, 10; total acidity, 20, no blood. Wassermann negative.

Pathological Findings.—Ulcer of lesser curvature about 4 cm. from pylorus.

Operative Procedure.—St. Luke's Hospital, November 10, 1915. Excision of ulcer. Perhaps for an ulcer as small as this specimen now looks the Balfour method of cauterization would have been an equally effective method of removal, with less deformity or interference with the normal contour of the stomach; but in the presence of active ulceration, surrounded by a considerable area of inflammatory oedema, which made the ulcer appear much larger than it now looks, excision seemed the safer procedure.

Present Condition.—Two and one-half months after operation. Patient has gained in flesh and strength and has none of old stomach symptoms or pain. Is constipated, however, and when markedly so has abdominal cramps, and radiographic examination made within the last few days shows that a gastric residue still remains, although there did not at the time of operation, or even from the present radiographs, appear to be much shortening of the lesser curvature, resulting in the fish-hook deformity commonly occurring after extensive V-shaped resection of the lesser curvature. Radiographs also show the presence of an ileal stasis. Dr. Douglas said that it was his belief that it is desirable to excise ulcers in this location, especially in a patient of over fifty years of age, both for the cure of the ulcer and to remove the possibility of the presence of or subsequent development of carcinoma, which most frequently develops in this part of the stomach wall.

DUODENAL ULCER—EXCISION

DR. DOUGLAS presented a woman, aged twenty-six years, who gave a typical history of duodenal ulcer for past two years, during which she had five distinct attacks, with periods of remission. Attacks characterized by indigestion and pain radiating into back, usually about two

DUODENAL ULCER

hours after meals. Pain sometimes relieved by vomiting, but would return when stomach was empty. During worst part of attacks had hunger pains and tenderness in epigastrium, relieved by eating, but not by sodium bicarb. Radiographic examination negative, except for six-hour stomach residue. Gastric analysis showed free HCl 60, total acidity 88. No blood. Wassermann negative.

Pathological Findings.—A small ulcer about $\frac{1}{2}$ cm. in diameter on anterior wall of first portion of duodenum.

Operative Procedure.—St. Luke's Hospital, December 19, 1915. The only evidence of ulcer was a small area which could only be indefinitely seen or palpated in the duodenal wall, and as its presence could not be positively determined an incision was made into the duodenum, which demonstrated its crater on the mucous surface. The ulcer was excised and the duodenal wall sutured.

Present Condition.—Six weeks after operation. No stomach symptoms.

It was of interest to note that radiographic examination sixteen days after operation showed no gastric residue or evidence of duodenal deformity.

The patient was presented to emphasize the importance of an incision into the duodenum to determine the diagnosis, if necessary, and to illustrate the ease and advantage of excision of the small ulcers occasionally found on the anterior wall of the duodenum.

DR. CHAS. N. DOWD said that warning may be given in regard to the excision of ulcers, especially those in the lesser curvature of the stomach. A small scar may represent a very extensive cicatricial contracture, and hence the rent which remains after the excision of such a scar may be enormous, necessitating an elaborate closure. In view of this, the Balfour method of cautery puncture is often a better procedure than excision.

As to the desirability of gastrojejunostomy in addition to excision, it seemed to him that it is generally desirable. Experience has shown that the chemical and mobile changes which follow this procedure are very desirable.

DR. DOUGLAS said that there is one point in regard to doing gastro-excision rather than enterostomy in these cases. It was that which had impressed him in all of them, even the one with syphilitic ulcer. There was a very considerable amount of induration and thickening of the wall of the stomach in the latter, but he could not find any mechanical obstruction of the pylorus. It was the same with the case of duodenal ulcer. There was no spreading of the induration or inflam-

mation about the ulcer, either in the duodenal case or in the gastric case, that appeared to interfere mechanically with the action of the pylorus. There must be, just as in some cases of chronic appendicitis, occasions when there is a reflex cause for the residue shown by all of these patients before operation rather than mechanical obstruction. He did not see very much reason, then, for doing a gastro-enterostomy in all cases if the cause of the reflex irritation is removed and the pylorus not interfered with mechanically by the operative procedure.

The patient with the ulcer of the lesser curvature still has his residue, however, and he thought the result would have been better had a gastro-enterostomy been done in addition to excision, and that this procedure is advisable in similar cases.

The reason for doing a pylorectomy in the third case was on account of the age of the patient, over sixty, suggesting the possibility of carcinoma.

LATE CHANGES FOLLOWING OPEN REDUCTION OF FRACTURE— DISLOCATION OF SHOULDER

DR. WILLIAM DARRACH presented a man, thirty-eight years of age, who had been thrown from a wagon, landing on his shoulder. Three days after the injury he came to the Roosevelt Hospital. The humeral head could be felt below the coracoid, rotating with the shaft. There was no crepitus. Under ether an attempt was made to reduce the dislocation without success. X-ray showed the head still out of the glenoid. A second and third attempt were likewise in vain, and after the last attempt, when traction had been used with the heel in the axilla, a complete motor paralysis of the whole extremity was noted.

He was then admitted to the ward, and on the twenty-third day after the injury an open operation was performed. Under gas and ether, a curved incision was made from over coracoid outward and downward for a distance of 5 inches. The curved flap was lifted up and the deltoid separated from the pectoralis major. The anterior fibres of the deltoid were then cut 1 inch from their clavicular attachment, the subdeltoid was divided to the outer side of the coracoid head of the biceps, exposing the site of injury. It was found that the lesser tuberosity had been torn off by the subscapularis, but had maintained its attachment to the periosteum below, the latter being stripped off from the upper portion of the humeral shaft. The outer shell of the greater tuberosity had also been torn away from the bone, but had also maintained its muscular and periosteal attachment. Thus the head and upper shaft had been separated from both tuberosities and the

OPEN REDUCTION OF FRACTURE

periosteum had been forced forward out of this sleeve and assumed a subcoracoid position. The lesser tuberosity lay interposed between the glenoid and the head and prevented reduction. The long tendon of the biceps was displaced behind the humeral head. The vessels which enter the humerus through the numerous foramina at the anatomical and surgical necks were all torn away. This factor explains to a large extent the subsequent changes in this shoulder.

By lifting the lesser tuberosity forward from its glenoid position and holding out the biceps tendon and greater tuberosity, the head was made to return to its normal position in the glenoid and was again surrounded by its tuberosity-periosteal sleeve. The rent in the latter, as well as the capsular tear, was repaired with chromic catgut. The cut deltoid was sutured with the same material and the skin with silk and a Velpeau bandage applied.

There was primary union of the wound and movements were not begun until three weeks after operation. The motor paralysis rapidly disappeared except for the triceps and deltoid, which did not regain their function for about four months. At the end of six months he was back at work and continued to improve for about a year. After a stationary period of several months he noticed a gradual decrease in the amount of abduction, which had reached about 60° , and of rotation. Coincident with this decrease in motion there appeared a grating in the joint, but almost no pain. Since that time there was a gradual increase in the grating and in the limitation of motion until one year ago.

Since then the process has been stationary. During this period X-ray examination has shown a gradual atrophy and flattening of the head. At present there is about 20° of abduction with only 25° of rotation at the gleno-humeral joint. He can raise his arm to within 10° of the horizontal and is able to continue his trade at full wages, though he says he cannot lay bricks above the level of his head.

The late appearance of these arthritic changes in the joint and their slow progress over a period of four years have been most interesting.

It is believed that the destruction of such a large proportion of the blood supply (and possibly nerve supply) of the humeral head, at the time of the accident, has been a potent etiological factor in this condition.

DR. HOWARD LILIENTHAL believed that it was safer to remove loose pieces of bone than to try to anchor them in position and secure an ideal anatomical result. A practically perfect functional result may be obtained even if the fragments are taken out.

In one case, which he reported some years ago, in which there was a complete separation of the head of the bone, he took the loose head

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of the humerus out, and got an absolutely perfect result, so that two years afterwards the man was able to move that arm as well as the other one; could put on his coat and put his arm up over his head.

As Dr. Darrach has suggested, this danger of absorption of bone is a real one, on account of lack of blood supply.

DR. CHAS. N. DOWD said that in considering Dr. Darrach's case of fracture dislocation of the upper end of the humerus there is given an opportunity to study the late changes which may follow this injury, an opportunity which does not often come. This bears on the problem of removal of the head of the bone when it has been separated from the shaft and is dislocated.

Most surgeons have made efforts to preserve the head under these circumstances and the results have not always justified the effort. If the replaced fragment is likely to atrophy, and if the upper end of the shaft is likely to give good function without this fragment, one need not make prolonged efforts at reduction but will be wiser to simply remove the fragment.

DR. DARRACH said that until about two years ago he was very enthusiastic about the open reduction in cases of fracture dislocation of the shoulder. Since then, having seen this and three other late cases, he was not quite as enthusiastic as he was; and yet in two cases of this kind, he had had results that are really far better than they would have been had the head been resected.

A fracture-dislocation of the shoulder is a great deal more common than had been supposed. He thought that almost all of the shoulder dislocations that can not be put back with very careful attempts are complicated by some fracture, and the usual type is a tearing-off of the greater tuberosity alone or tearing with that of the lesser tuberosity.

Very frequently it is a mere shell of bone which comes off, and it may not be thick enough to throw any shadow with the X-ray. In most of the lesser tuberosities he had seen, it does not show up in the X-ray at all; so it is a fair guess, if the dislocation does not go back at an early attempt, to say that one or both of the tuberosities are broken off.

As to removing loose fragments, if the fragments are actually loose, it is a very good rule to follow, but in such a case as this was, where the tuberosity was torn off the bone and yet maintained its periosteal attachment, and also the attachment of the rotating muscles, the case was different.

If, however, there is a small fragment, as seen in some of these greater tuberosity breaks, which is simply tilted out a little bit, so that



FIG. 1.—Change in shape of thigh caused by exostoses of femur.



FIG. 2.—Exostoses of femur and of tibia.



FIG. 3.—Exostoses of humerus.

SEPTIC INFARCT OF THE LUNGS

it presents a rough surface, projecting into the subdeltoid bursa, that fragment ought to be removed. Only in that way can one stop a bursal irritation.

In the dislocations of the shoulder with fracture, or in dislocations alone, where the head has been out for any length of time, that is, if it has been out for four or five or six weeks, or even six months, a better result can be secured by taking out the head than by reducing it; but in the early cases there is a distinct field for the open reduction.

MULTIPLE CARTILAGINOUS EXOSTOSES

DR. ALEXIS V. MOSCHCOWITZ presented a man, thirty-one years of age, who was referred to him by Dr. Lefkovics, December 3, 1915. His principal complaints were pain and a peculiar sensation of persistent coldness in the left leg and foot; in addition, he also complained of inability to walk in comfort for more than a block or two. He was aware of the existence of a tumor upon the back of the corresponding thigh for a period of eight years, which had increased but very slowly in size. He had not noticed any other tumors, or at least he had paid no attention to same.

On physical examination it was seen that the patient was somewhat short in stature, with very well-developed muscles. The left popliteal space was occupied by a tumor the size of a grape-fruit, which was of a bony consistence and was attached to the posterior surface of the femur (Figs. 1 and 2). A number of other tumors were also found scattered throughout the body. Upon subsequent X-ray examination they were able to count forty-three (Fig. 3). The tumor upon the left femur caused pressure upon the popliteal vein, as was evidenced by a cyanosis, and a sensation of cold in the foot.

The man was operated upon December 10, 1915, at the Har Moriah Hospital. As is usual in these cases, a bursa covered the exposed cartilaginous surface of the exostosis.

Both objectively and subjectively the patient has been well ever since the operation.

SEPTIC INFARCT OF THE LUNGS FOLLOWING APPENDICITIS

DR. ALEXIS V. MOSCHCOWITZ presented a man, twenty-five years of age, who was admitted November 24 to the Har Moriah Hospital, suffering from an acute appendicitis, and was operated on November 5. A gangrenous perforated appendix, buried in old adhesions, and surrounded by an abscess cavity containing about one ounce of foul-

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smelling pus, was extirpated; the abscess cavity was drained by a cigarette drain.

The subsequent course for one week was absolutely uneventful. The slight temperature, 99°–100° F., could very well be accounted for by absorption from the abscess cavity. The patient was considered absolutely out of danger and convalescent, when on the seventh day he had a chill, followed by a temperature of 103° F. On careful examination there was found a small patch of dulness over the lower lobe of the right lung, posteriorly, near the vertebral column, with bronchophony and bronchial breathing. A pneumonia was diagnosticated at first, but the subsequent course of the temperature, the repeated occurrence of chills, etc., soon changed the diagnosis into that of a septic infarct of the lung. This was verified subsequently also by X-ray examination. Repeated aspirations failed to reveal any pus; a little cloudy fluid withdrawn from the pleural cavity showed the presence of Gram-positive diplococci. One week later the temperature dropped to normal and did not rise thereafter. During the week with febrile symptoms the patient was critically ill, and the outlook was very precarious; but, after the fever stopped permanently, the convalescence was very rapid; the physical signs, however, persisted for a very long time.

FOREIGN BODIES IN THE RESPIRATORY TRACT

DR. N. W. GREEN read a paper, with the above title, for which see page 656.

Stated Meeting, held February 23, 1916

The President, DR. CHAS. N. DOWD, in the Chair

OBLITERATING THROMBO-ANGIITIS ACCOMPANYING LEAD POISONING

DR. CHAS. N. DOWD presented a man whose leg he had amputated six inches below the knee for obliterating thrombo-angiitis. The etiology of the condition was remarkable—most of the patients seen with obliterated arteries are natives of Russia or adjoining locality, in early manhood. This man is an American, a house-painter, age thirty-six, who was apparently in good health until two and a half years ago, when he noticed symptoms of intermittent claudication in the calf of his left leg. He could walk only about half a block at a time without great pain and the necessity of resting. The symptoms continued about the same until eleven months ago, when he ceased walking, excepting with

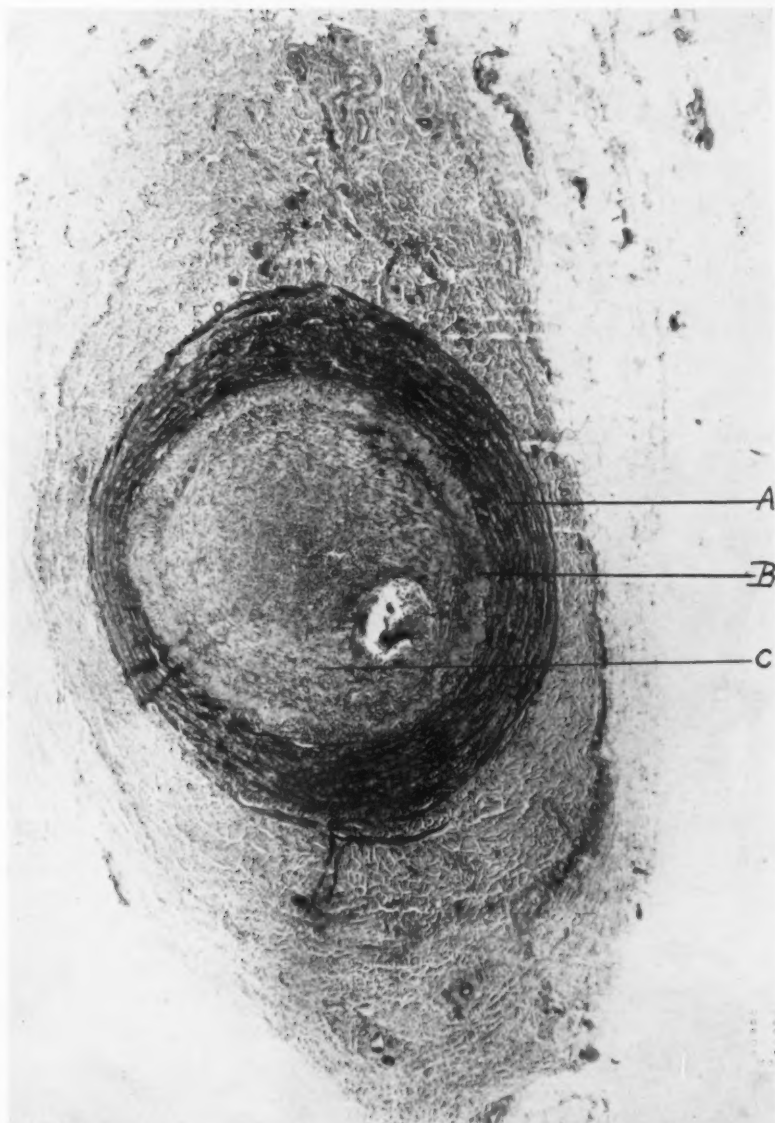


FIG. 1.—Microphotograph of transverse section of posterior tibial artery, showing thromboangiitis obliterans. A, media infiltrated with connective tissue; B, connective tissue replacing the intima; C, organized deposit of fibrin containing giant-cell.

Trial	Control (n=10)	MCI (n=10)	AD (n=10)
1	85	75	65
2	80	70	60
3	75	65	55
4	70	60	50
5	75	65	55

OBLITERATING THROMBO-ANGIITIS

a cane and crutch. Thirteen months ago he noticed a small blood blister under the left little toe which stung and burned. It was opened two months later and has kept on sloughing since. At one time he was given hot electric light baths on the foot and the wound healed, excepting a very small spot. It was always very sore and at present pains severely at night. Last October the ulcer was operated upon and curetted. Instead of healing it has kept on sloughing. Then the small toe began to slough away and the pain was so severe that a portion of the metatarsal bone was also removed on December 8. The sloughing continued as before and now the next toe and the tissues at the base appear gangrenous.

He was sent to the Roosevelt Hospital from the Neurological Institute with the diagnosis of endarteritis due to lead poisoning, and lead had been found in his urine.

He had worked at his trade as a painter for twenty years and had not known that he had lead poisoning, although he had a dark line along the dental border six months ago.

No alcoholic or venereal history: he smokes about three ounces of tobacco a week.

His condition was found to be good, excepting his left leg, which was thinner than the right. No pulsation could be felt in the left femoral artery or its branches, although there was good pulsation in the arteries of the right leg.

There was an ulcer with gangrenous base involving the fourth left toe and adjacent part of the foot. The fifth toe and metatarsal bone were absent.

Wassermann reaction negative. Pupils slightly uneven in size but react both to light and distance. Reflexes normal. Blood-pressure in both arms, 132.

He suffered intense pain in his left leg and foot at night, and after a few days of observation amputation was done six inches below the knee. The selection of the site for amputation was not easy, since we had had no experience with the obliteration of arteries from plumbism and found no one who had. It seemed fair, therefore, to follow a conservative course, and amputate below the knee. There was very little bleeding in the flap and healing is tardy, but will probably be secured. The aperiosteal method was used, and even now he can bear considerable pressure on the stump, excepting at one part of the suture line, which is still open.

The recent studies in industrial welfare have added much to our knowledge of lead poisoning. Its manifestations are manifold; the

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nervous system is especially likely to be affected and the symptoms are dependent upon the site of the lesion. Sir Thomas Oliver's monograph¹ gives the details of extensive observations.

Vaughan² and V. Schrötter³ refer to the obliterating endarteritis which accompanies the disease.

The microscopical appearance at a cross-section of one of the arteries is shown in the accompanying microphotograph. The organized central thrombus, the thickened media and the replacing of the intima by connective tissue are all shown. Dr. Mortimer Warren's pathological report is appended.

Sections.—Six, of anterior and posterior tibial arteries. Vein and nerve.

Microscopic Examination.—(A) Sections show small bundles of nerve tissue in which there is a moderate amount of connective tissue between the nerve fibres. Several small arteries and acini seen which seem to show considerable amount of connective tissue in the media.

(B) Shows cross-section of artery. The lumen is filled with a well-organized deposit of fibrin containing one giant cell. The intimal endothelium is gone; the intima itself replaced by a generous amount of connective tissue. The media shows wide separation of muscle bundles due to infiltration of connective tissue.

Microscopic Diagnosis.—Interstitial neuritis; endarteritis obliterans.

A chemical and electrolytic examination of the muscles of the amputated leg was made at the Neurological Institute and much lead was found in them.

AMPUTATION STUMPS

DR. DOWD presented a man, age thirty, whose leg he had amputated by the aperiosteal method for an extensive basal-celled epithelioma. The amputation was at the junction of the middle and lower thirds of the thigh. As soon as healing was complete, bathing, massage and pressure were applied by the method which Dr. Lyle has advocated. He left the hospital three weeks ago, wearing a peg-leg with a plaster-of-Paris socket fitted for an end-bearing stump. He stood the pressure well and walked well. He returns this evening with a crutch instead of his peg-leg, saying that a tender spot had appeared at the side of the stump, but the end of the stump is good and he can endure much pressure there without pain. The stump was better than the average and furnished a good possibility for an artificial leg which would utilize the "end-bearing" principle.

¹ Sir Thomas Oliver: Lead Poisoning, New York, 1914.

² Victor C. Vaughan: *Forscheimers Hoeber Therapeutics*.

³ V. Schrötter: *Nothnagel's Handbuch*.

AMPUTATION STUMPS

Dr. Dowd said that he thought that stumps must be adjusted to the conditions present at the time of operation. Personally, he saw very few amputations with clean, well-nourished stumps. Most of the amputations are done for tuberculosis or for obliterating thromboangiitis. In the former, infection has usually spread into tissue which should be preserved, and in the latter the circulation is usually imperfect. Last year, after Dr. Lyle brought this subject before the society, he amputated at the thigh for tuberculosis of the knee of very long standing, pushing back 1 cm. of periosteum and scooping out a corresponding amount of marrow. There was a delay in the healing, and finally a ring of bone came away, which represented the end of the femur, from which the periosteum had been removed. Since then he had pushed back very little periosteum and had hardly touched the marrow. He did not think this case an argument against the aperiosteal method, but did consider it an indication that in badly-nourished bones neither the periosteum nor medulla should be widely disturbed.

DR. H. H. LYLE said that Dr. A. Moschowitz had shown such a case before this society. Since then Dr. Lyle has been removing only .5 cm.; formerly he removed 1 cm. Reports of circular sequestration of the stump end occurring in the periosteal method are not uncommon. Dr. Lyle said he considered the osteoplastic the ideal method, given ideal conditions. Given infected conditions, the aperiosteal is ideal. It is possible to get an end-bearing stump in a large per cent. of the infected cases if the aperiosteal method is employed.

DR. WALTON MARTIN said that he believed the aperiosteal flap gives a better stump than the periosteal flap. Infection, however, plays a very important part. He remembered one of the cases shown by Dr. Lyle; there were several long, sharp, bony spurs and a pus-discharging sinus in the end of the stump. It was a good example of one of the effects of infection in an amputation stump. It seemed to him that rough handling of the periosteum and the tearing away of the muscular attachments is also important.

He has recently had experiences which bear out the statement that instrument makers prefer artificial limbs which do not bear weight on the end of the stump. They often prefer an amputation being done higher than is necessary, so that a complete limb may be used, supported from the pelvis rather than lower down. One reason for this is, that these ingenious devices show the skill of the instrument maker to greater advantage.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting, held February 7, 1916

The President, DR. CHARLES H. FRAZIER, in the Chair

TOTAL CYSTECTOMY ONE AND A HALF YEARS AFTER OPERATION

DR. B. A. THOMAS presented a man, aged forty-two years, who was first cystoscoped by him January 23, 1912, on account of frequency of urination and dysuria. At that time small nodules or tubercles were discovered on the posterior aspect of the vesical sphincter. A few days later these were removed and a pathologist reported them to show "inflammatory changes but no evidence of tuberculosis." The patient was temporarily relieved but in a few weeks his symptoms returned with greater severity, and he was treated for over a year by several physicians, being cystoscoped frequently, both with and without general anaesthesia. His treatment consisted mainly of prostatic and vesical neck "punch operations," "fulgurations" or high frequency electro-coagulation, suprapubic cystotomy, etc. On September 30, 1913, he again came under the care of Dr. Thomas. At this time the patient's condition was deplorable. He was obliged to urinate very frequently with excruciating pain; had been utterly incapacitated from work for a year and a half, and threatened suicide.

Cystoscopy done at this time at the Polyclinic Hospital revealed multiple, variously sized, small tumor formations completely covering the trigonum and vesical neck, obscuring the ureteral orifices from view (Fig. 1). A few of these growths were removed by the cystoscopic rongeur for histo-pathological examination, and were reported by Dr. John A. Kolmer to be "inflamed polypi." On November 11, the bladder was opened suprapubically and the entire trigonum and vesical orifice thoroughly cauterized with the actual cautery. The patient was relieved for a month or six weeks, when his symptoms returned, and cysto-urethroscopy demonstrated the presence of reforming polypi about vesical orifice and in prostatic urethra. In view of the generally poor results following ureteral transplantation into the rectum, it was decided to perform bilateral nephrostomy, supplemented by total cystectomy. The left kidney was nephrostomized January 13, 1914; the right,

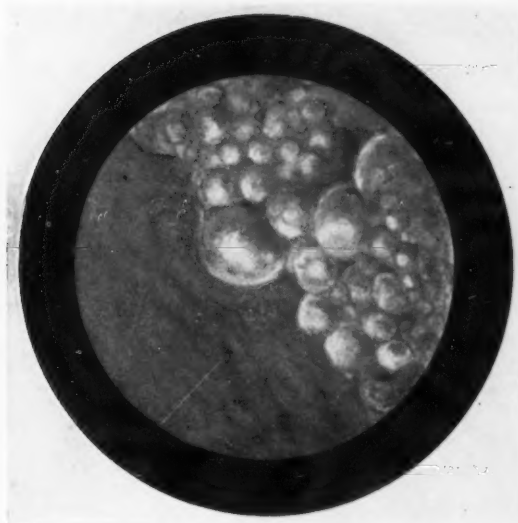


FIG. 1.—Cystoscopic appearance of multiple inflamed polypi covering trigonum and vesical orifice.



FIG. 2.—One or the other of these sterling silver tubes is placed in the renal fistula and the tract permitted to granulate around it. Should phosphatic incrustations occur to interfere with the drainage, the tube must be removed for cleansing; in which event the bulbous expansion is not practicable, and tube *B* should be substituted and held in position by adhesive plaster. In order to make the drainage water-tight, the tube may be expanded conically for a short distance above the circular flange.



FIG. 3.—Posterior view of renal drainage apparatus. The silver tubes here shown are the same as A in Fig. 2. By expanding the tube near the flange and securing same close to the skin, the apparatus may be made almost, if not quite, water-tight.

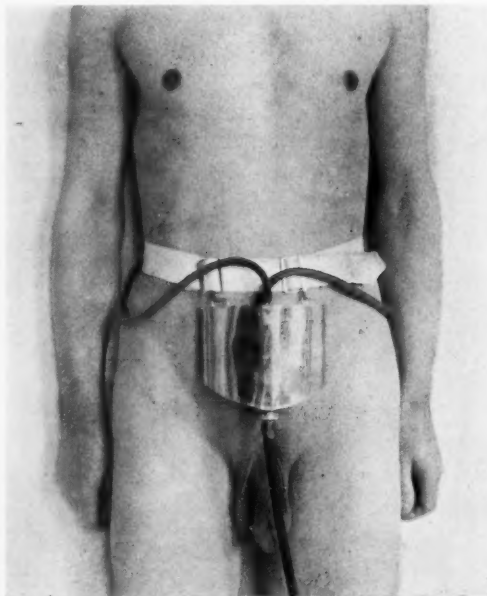


FIG. 4.—Anterior view of drainage apparatus, showing receptacle suspended over suprapubic region. The tubing attached to the bottom of the reservoir may or may not be utilized.



FIG. 5.—Carcinoma of penis of nine months' duration. Observe metastasis to right inguinal lymph-node.



FIG. 6.—Appearance of external genitalia four and a half years after amputation of penis for carcinoma. Patient can urinate in erect posture quite satisfactorily.

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AMPUTATION OF PENIS FOR CARCINOMA

February 24. The patient was markedly relieved after these operations for several months, save that he had to have his left ureter re-ligated with silk, the original catgut ligature becoming absorbed and permitting of partial patency of the ureter. On November 6, 1914, total cystectomy was done, the patient showing a remarkable convalescence. Four months later he began to complain of discomfort in the perineum and pain, referred down the urethra, associated with a slight mucopurulent discharge from the meatus. Suspecting involvement of the prostatic urethra and realizing from the beginning that the prostate was very slightly enlarged, a radical perineal extracapsular prostatectomy and posterior urethrectomy were performed. In order to minimize the danger of recurrence of these growths, 50.5 mg. of the element radium were implanted deeply in the perineum for 48 hours.

The renolumbar fistulae have been fitted with sterling silver tubes (as shown in Fig. 2). These are connected with light rubber tubing to a flat metal receptacle suspended over the suprapubic region (Figs. 3 and 4). Thus equipped this man has been in good general health and practically free from pain for months; has little difficulty in keeping himself dry; requires dressing but once a week, excepting what he can do himself; goes about in- and out-of-doors at his leisure, and is able to do light work in comparative comfort.

The reporter thought this case to be worthy of record, not only as vindicating the feasibility of Watson's suggestion made in 1906, but because it marks the first instance in which the procedure has been successfully accomplished, and illustrates the practicability of the utilization of a satisfactory renal drainage apparatus.

AMPUTATION OF PENIS FOR CARCINOMA: CONDITION FOUR AND A HALF YEARS AFTER OPERATION

Dr. B. A. THOMAS presented a man, aged fifty-eight years, who came to the Polyclinic Hospital in October, 1911, with a typical carcinoma of the glans penis, involving the urethra, with metastasis to the inguinal lymph-nodes on the right side (Fig. 5). He stated that he had noticed the lesion on penis for nine months. The inguinal lymph-nodes in both groins were thoroughly removed and the penis amputated as close to the pubic arch as possible. Dr. John A. Kolmer, who examined the specimens pathologically, reported "carcinoma of the penis with metastasis to at least one lymph-node."

The patient convalesced satisfactorily and when seen last, February 7, 1916, had gained 40 pounds in weight, enjoyed excellent health, worked every day, and showed no signs of recurrence or metastasis (Fig. 6).

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The case is of interest, first, owing to the fact that the patient has been free of any signs of recurrence or metastasis for $4\frac{1}{2}$ years, although at the time of operation metastasis was present in the inguinal lymph-nodes; second, because complete extirpation of the penis with perineal urethrostomy was not done, necessitating the patient to sit down in order to urinate; and third, because the patient can urinate quite satisfactorily in the standing posture.

DR. E. H. SITER said that of 12 cases of cancer of the penis that had been under his observation, 2 were inoperable; 10 were operated upon. In 2 of these operated cases an amputation was done and in the other 8 a total extirpation, including the scrotum. The best interests of the patient in these operations, he thought to be served when the urethra is brought out in the perineum. There is better control and no excoriation. After total extirpation of the entire genitalia there was a smaller percentage of recurrence.

Some five years ago he operated upon 2 cases in Blockley, doing a total extirpation. These patients he had seen within six months and they have had no recurrence. Where only an amputation was done he had invariably had recurrence.

DR. ALEXANDER RANDALL said that carcinoma of the penis presents many phases of difference from carcinoma elsewhere. Metastasis and the time of recurrence in carcinoma of the penis are apparently very late. The apparent immunity of the circumcised is peculiar to all. In 100 cases reported by Barney in the ANNALS OF SURGERY for 1907, some interesting points were brought forward. He found 85 per cent. of the cases had congenital phimosis, about 60 per cent. had carcinoma in the inguinal glands, and that 75 per cent. had enlarged inguinal lymph-glands. The growth was an epithelioma in practically every case. There were 26 recurrent cases in this series. Under one year there were 12 cases, or 39 per cent.; from 1 to 2 years, 6 cases, or 19 per cent.; from 2 to 3 years, 5 cases, or 16 per cent.; 3 to 4 years, 2 cases, or 6 per cent. In from 4 to 5 years there were no recurrences. After five years there was recurrence in 12 per cent. He likewise shows that a patient may live over 11 years from the time of onset of the cancerous growth. The operation of choice is the operation of Nicoll, published in 1909, which is more surgically a cancer operation like that used in carcinoma of the breast, because he takes out the inguinal glands and lymph-channels down to the dorsum of the penis and the penis itself, all in one piece, starting outside the zone of cancer and working towards the primary growth, making a complete resection of all involved tissue. This is the ideal operation, rather than that of amputation of the penis,

FRACTURE OF FIRST LUMBAR VERTEBRA

and just a single excision of the glands on either side, through separate incisions.

FRACTURE OF FIRST LUMBAR VERTEBRA WITHOUT NERVE SYMPTOMS

DR. FRANCIS OLCOTT ALLEN said that among the patients at the Insane Department of the Pennsylvania Hospital there was found a woman of forty, small, slightly built, but physically well. About midnight, June 18, 1915, she managed to get out of a second-story window and dropped to the ground, some twenty or twenty-five feet below. From an examination of the soft earth under the window, it was apparent that she had landed on her feet and then on her buttocks. She got up and made her way across the grounds for a distance of several hundred feet. She was then overtaken, brought back and put to bed.

He saw her about an hour and a half after this escapade. She was sitting up in bed, talking incessantly, entirely preoccupied with her own ideas, and paying no attention to the severe injury she had sustained. Examination revealed a marked swelling of the soft parts in the lumbar region, with a distinct kyphosis. This area was tender and gave some pain on certain motions of the trunk. No paralysis or other signs of a cord lesion could be made out. A skiagram was taken the next day and showed a fracture of the first lumbar vertebra. Owing to the disturbed mental state the patient was allowed to do as she pleased, as far as her injury was concerned, sitting up in bed most of the time, until she was able to be about. Her mind gradually recovered and she returned to her home, where she now is assisting her husband in a bakery. At a further examination made January 17, 1916, just seven months after injury, there was found a distinct kyphosis in the region of the first lumbar vertebra, with ankylosis of the adjacent spine. There was some tenderness over the spine just below the kyphosis, but no other physical findings were noted. The patient said that her injury did not prevent her from doing her work or anything she wanted to do. She complained of some pain in the lumbosacral region, of a sense of weakness when she did not wear corsets, and of her back feeling tired at night after doing her work in the bakery. Dr. Bowen reports on a skiagram made the same day:

The body of the first lumbar vertebra is considerably deformed but there is no evidence of the previous line of fracture. This vertebra will eventually be ankylosed with the twelfth dorsal and the second lumbar. A considerable part of that process is already accomplished.

PHILADELPHIA ACADEMY OF SURGERY

The interesting feature of this case is, of course, that the cord and spinal nerves escaped even temporary injury. The spinal cord proper ends at the level of the lower part of the first lumbar vertebra, but through the canal of the first lumbar there also pass the nerves supplying sensation as high as the groin, and motion to the legs below the knees, as well as control of the bladder and rectum. In injuries of this portion of the spine, some or all of these functions are usually affected, and it is extraordinary that, in as marked a bony lesion as this patient presents, there should not be sufficient impingement upon the canal to cause pressure upon the nerve structures.

DR. HENRY R. WHARTON had had under his care two cases of fracture of the lumbar vertebræ which presented no marked symptoms of spinal injury. One was the case of a young woman of eighteen years of age who fell under a trolley car. There was marked kyphosis and a little evidence of loss of power in the lower extremities; some anæsthesia of the anterior surface of the thighs. The other case was that of a woman of twenty-five who jumped out of a burning apartment house in West Philadelphia, alighting on a bank of snow. He saw her a short time after the accident. There was fracture of the second lumbar vertebra, as shown by X-ray examination, and marked kyphosis. The only symptom of spinal injury was anæsthesia of the anterior surface of the thighs. Dr. Burr saw the latter case with him and found no evidence of spinal injury except the skin anæsthesia previously noted. Both patients made good recoveries and have good use of their limbs. He had seen both within a year. They walk perfectly well, although they still have marked kyphosis in the lumbar region at the site of injury and have slight rigidity of the spine in bending. Otherwise their conditions are excellent.

CASE OF HERMAPHRODITISM

DR. FRANCIS OLCOTT ALLEN gave the history of a second patient, a woman of forty-three, unmarried, an inmate of the Insane Department for many years, suffering from dementia præcox. Double inguinal hernia had been present since infancy. She had never menstruated, and vaginal examinations, the first when she was fourteen years old, showed that neither cervix nor uterus was palpable. When Dr. Allen saw her, on June 25, 1915, she had been ill for two days with an attack of vomiting and apparent abdominal discomfort. Her mental condition was such that it was not possible to be sure of her subjective sensations. She had had similar attacks before, but none so severe as the present one.

CASE OF HERMAPHRODITISM

On examination there seemed to be tenderness in the lower right abdomen, but whether its seat was in the inguinal or the appendiceal region could not be determined. There was no muscular rigidity, nor was any hernia discoverable in her recumbent position. Her temperature was 101° and there was a leucocytosis of 17,000; 86 per cent. polymorphonuclear. He operated upon her the same day, removing a normal-looking appendix, which was later reported to show, microscopically, a chronic inflammation. On exploring the pelvis, no uterus, tubes, or ovaries could be found. At each internal ring there was a small body about the size of an ovary. His incision was through the right rectus, so that he could do no more than determine the presence of such a body on the left side. The one on the right side slipped readily in and out of the ring and was evidently the content of the hernia. He decided to remove this organ in order to prevent the recurrence of the hernia, and in doing so found that it was retroperitoneal; that extending from it into the inguinal canal there was a band of tissue; that a duct-like cord ran retroperitoneally toward the midline; and that another duct-like structure, also retroperitoneal, passed upward, under the cæcum, toward the kidney. There were no signs of peritoneal inflammation, past or present, and these three attachments were not adhesions but definite structures. The peritoneum was divided, the three structures mentioned ligated and cut, and the organ removed. The peritoneum was sutured over the uncovered surface and the abdominal wound closed.

The patient recovered and returned to the Insane Department, where she still is. She has not had any attacks of vomiting, such as she formerly had, and is physically well. Her mental state is unchanged.

The organ removed is described by Dr. Orton, of the Laboratory of the Insane Department, as follows:

Specimen consists of a mass of tissue of irregular form partially covered with serous membrane and made up of two closely associated masses. One of these is a roughly oval mass about 2.5 by 1.7 by 1.6 cm. in size and closely associated with a larger, more irregular, mass. Partly encircling the smaller mass and attached to it at either end is a cord-like or tubular structure varying in diameter from 2 to 6 mm.

Gross Appearance.—On section the smaller oval mass has a whitish, coarsely granular appearance, characteristic of a section of testicle, while the mass below shows numerous large vessels and a moderate amount of rather intense congestion.

Microscopic Examination.—Small pieces of the smaller mass fixed in Zenker's fluid and in formalin. Remainder fixed *in toto* in Kaiserling.

Zenker fixation, paraffin sections, eosin and methylene blue stain: Section is covered on one side by heavy fibrous tissue capsule. Main portion is made up

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of tubular structures between which lie many close-packed masses of cells. The tubules are made up of light connective-tissue strands, containing, for the most part, loosely grouped, rather indefinitely formed cells with relatively few and rather small nuclei. In many instances the tubules are more or less filled with this material; in others, it forms a distinct parietal zone surrounding a lumen and with a general radial arrangement of protoplasm and nuclei.

In general, the microscopic picture of this section conforms entirely with that of a cryptorchid testis from a male or with the advanced stages of testicular atrophy seen as a result of hypophysectomy, in both of which there is complete or almost complete absence of cells of the spermatogenic series, but with the preservation of the tubular connective-tissue reticulum, in whose lumina lie the more or less altered remains of cells, which probably represent the sustentacular cells of Sertoli, and with a striking complement of the interstitial cells of Leydig.

This histologic diagnosis is borne out by the anatomic relations I have described—the gubernaculum passing ahead of the testicle into the inguinal canal and the vas deferens inward toward the seminal vesicles behind the rectum. The other duct-like structure running toward the kidney can be explained by assuming a persistent embryonic Müller's duct.

An examination of the patient's external genitalia and secondary sexual characters showed no evidence of even a tendency to masculinity. The bony frame was small; the distribution of hair typically feminine; the breasts as well developed as those of normal single women of the same age and build; the vulva, nymphæ, and urethra normal in appearance; the vagina of fair size, ending in a blind pouch; the clitoris not enlarged.

On the accepted theory that the internal secretion of the genital gland is the determining factor in the secondary sexual manifestations, this individual would be expected to be masculine in type. The only way to account for the findings as they are is to assume that ovarian tissue is also present and functionally predominant. It may be that the organ at the left ring is an ovary, though it seemed at operation precisely like the one removed. Or there may be ovarian tissue elsewhere, which was not found at operation. There are other cases recorded in which both testicular and ovarian tissues were present.

This patient's family history is very curious in connection with her own genital anomaly, and suggests a possible hereditary factor in her case. Her maternal grandmother was one of a large family, among whom two married sisters had no children. Her mother was one of



FIG. 7.—Fracture of tuberosity of scaphoid of foot by muscular action.

1990

FRACTURE OF FOOT BY MUSCULAR ACTION

seven sisters and two brothers. Of these, three sisters never menstruated. One of the three was examined some years ago and was found to have "testicles." What such a report means is, of course, uncertain, but it indicates some anomalous condition. The patient herself is the only abnormal member of her immediate family, both of her sisters having normal menstruation, and one of them a normal child.

FRACTURE OF THE TUBEROSITY OF THE SCAPHOID OF THE FOOT BY MUSCULAR ACTION

DR. GEORGE ERETY SHOEMAKER described an unusual variety of injury which simulates a sprain of the foot, but in reality is a more serious lesion. The patient was a normal young woman of thirty years, lately convalescent after a pregnancy, but otherwise well. The injury was occasioned by so slight an application of force as stepping from an automobile to the pavement, where a slight irregularity turned the foot, clad in a light, low shoe. She fainted with the pain and fell, but only after the injury; consequently, the injury was due to muscular action. An ordinary adhesive plaster dressing of strips, alternating in direction, applied by the Gibney method, proved intolerable, causing pain from pressure under the inner side of the arch of the foot, where was the point of greatest tenderness. Another dressing was applied with like result. Crepitus was not obtainable, perhaps on account of swelling. The X-ray showed that the tuberosity of the scaphoid was broken off or separated, the fragment being a half inch in thickness and not a scale. By comparison with the normal scaphoid of the other foot, the slight displacement and the line of separation are seen very distinctly.

A question arises as to whether this was a fracture or a separation of the tuberosity, because Piersol (*Anatomy*, page 425) says that the end of the knob of the tuberosity is sometimes distinct from the scaphoid and is then known as the *tibiale externum*.

Spalteholz does not mention any such anomaly, nor does Cunningham or Quain; moreover, anomalies of this type tend to be bilateral if present, but here the other scaphoid is all in one piece.

The main portion of the tendon of the *tibialis posticus* muscle is inserted in this tuberosity and it is easy to understand the powerful force brought to bear by a misstep upon this support of the arch of the foot. I believe the condition to have been one of fracture of the scaphoid. If unrecognized by the X-ray, and therefore not treated by fixation for a sufficiently long time, the disability from such an injury

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would likely be lasting, because the tibialis posticus would move the fragment and prevent union.

A plaster-of-Paris dressing gave immediate relief from pain. The treatment was that of fracture. Convalescence was normal, but it was a year and a half before occasional discomfort failed to be felt under strain.

EXPERIMENTAL COLONIC STASIS

DRS. CHARLES H. FRAZIER and MAX M. PEET read a paper with the above title, for which see page 729.

HIGH INTESTINAL STASIS

DRS. J. E. SWEET, MAX M. PEET, and B. M. HENDRIX read a paper with the above title, for which see page 720.

DR. JOHN H. JOPSON said that surgeons had long noted that the poison responsible for the fatal results in cases of acute intestinal obstruction was much aggravated in its action both by the anæsthetic and by operations for the relief of the obstruction when the bowel was not drained externally. Cases of intestinal obstruction may come to the operating table in fair condition, and shortly after anæsthesia is begun, and also after the liberation of the obstruction, the patient will go down very rapidly. The advantages of enterotomy and enterostomy are well recognized, although there is still some difference of opinion as to the advisability of the formation of a fecal fistula. In cases of spontaneous establishment of fecal fistula, the rapidity of improvement is oftentimes most striking. Perhaps Dr. Sweet can say whether the sudden relief of the obstruction in the bowel is followed by rapid absorption in the hitherto distended portion, or does the absorption take place lower down after the obstruction is relieved?

Regarding the work of Drs. Frazier and Peet of reversal of the colon in the dog, he did not think this furnishes a thorough criterion of the conditions found in the human subject. Clinical experience has demonstrated that cases presenting marked ptosis of the large and small bowel, associated with constipation, are relieved and made more comfortable, as a rule, so long as the constipation is overcome by medicinal or operative measures. Almost any one of the several operations which have been recommended for intestinal stasis will give relief, temporary perhaps, but still marked for the time. One should not, therefore, discard the whole theory of intestinal stasis in its relation to colonic absorption on the testimonial of experimental work alone, when it is strongly controverted by clinical experience.

HIGH INTESTINAL STASIS

DR. A. E. TAYLOR said that there are four obvious possibilities in the intoxication to be observed in high intestinal obstruction and in colonic stasis:

Intoxication by retention of toxic substances secreted by or formed in the glands of the digestive apparatus and the intestinal mucosa.

Intoxication by absorption of half-way stages of protein or lipid digestion, or by abnormal intermediary stages.

Intoxication by products of bacterial action on the products of the digestion of protein or lipid.

Intoxication by specific bacterial poisons, in really representing specific infectious processes.

It is likely that many so-called gastro-intestinal intoxications are in reality specific bacterial infections involving the alimentary tract, but the bacteriology of the fæces is in such a state of confusion that it has not been possible to isolate and identify the pathogenic organism in accordance with established procedures.

Intoxications under factors one and two may reasonably be restricted to high intestinal obstruction; intoxication under factor three may reasonably be restricted to colonic stasis.

Bacteria operating, in the colon largely, upon the end-products of protein digestion seem to display, in accordance with the characteristics of the particular flora, three directions of reaction: direct reduction, leading to the splitting off of ammonia and the conversion of the amino-acid back to the corresponding fatty acid; hydrolysis, with splitting off of ammonia, and leading to the corresponding hydroxy-acid; and the so-called carboxylase reaction, carbon dioxide being split off and the corresponding amine formed. It seems reasonable to infer that certain flora react in the one direction, other flora in another. The formation of amines tends to the production of substances likely to have toxic properties, especially the amines of the basic histone bodies, which exist in nature in the ergot, and one of which, imidazoethylamine, is very toxic. It is clear, both from the results of these experiments and from clinical experiences, that mere retention of normal stools in the colon, under certain conditions of bacterial activity, need not necessarily lead to the formation of toxic substances. The exact toxic cause of the symptoms in high intestinal obstruction has not been established.

DR. SWEET, in reply to Dr. Jopson, said that it has been found that substances such as strychnia are absorbed with difficulty from the obstructed loop. It has been found that the specific poison of high obstruction is not absorbed from the normal intestine. Nevertheless,

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there is clinical evidence that the material above an obstruction can cause symptoms of intoxication if allowed to pass down the gut, and it should be noted that neither of the two experiments I have just mentioned actually corresponds to the clinical condition. The intestine below an obstruction is not necessarily a normal intestine, and it is conceivable that rapid absorption might take place, as, in fact it seems, occurs in clinical practice.

JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

DR. NATHANIEL GINSBURG read a paper with the above title, for which see page 732.

DR. JOHN H. JOPSON had had one case of ulcer at the stoma following gastro-enterostomy for perforation of a duodenal ulcer. The symptoms of ulcer had been present for ten years before perforation had taken place. At operation the perforation was found temporarily sealed by adhesions. It was sutured and a posterior gastro-enterostomy performed, using catgut for the inner and Pagenstecher for the outer sutures. The ulcer symptoms recurred about five and a half months after operation. There was hunger pain, paroxysmal in type, coming on especially in the afternoon and during the night, without vomiting. An area of tenderness was present just to the right of the middle line and between the ensiform cartilage and the umbilicus. Pain would begin over a small area and spread downward. The patient could not take any solid foods without pain. Liquid diet gave moderate relief. At operation, in July, 1914, the pylorus was found buried in adhesions and was not disturbed. There was a perforating ulcer at the gastro-enterostomy opening involving both stomach and jejunum, covered in by recent adhesions, not leaking but bleeding freely when exposed. It was 2 cm. in diameter. It was sutured and anastomosis performed between the proximal and the distal portions of the jejunum below the gastro-enterostomy opening.

This operation was not followed by permanent relief. There was marked hyperacidity of the gastric secretion subsequently and frequently blood present in considerable quantities in the stools. The patient was fairly well on liquid diet. When last seen he was better, but still suffering from ulcer symptoms.

DR. GEORGE G. ROSS mentioned a case in his service at the German-town Hospital, a man upon whom he did a gastro-enterostomy for gastric ulcer. Two years after the operation the man came back to the hospital in the middle of the night with a perforated gastrojejunal

JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

ulcer. He was operated upon by Dr. Swartley. The case will be fully reported at a future meeting of the Academy.

DR. DAMON B. PFEIFFER recently saw a case which seems to throw some light upon the rôle of unabsorbable sutures in gastrojejunal ulcer. The case occurred in the service of Dr. Deaver and was that of a woman who at operation was found to have duodenal ulcer of chronic type. The ulcer was excised, the duodenum inverted and sewed to the denuded head of the pancreas, and a posterior gastrojejunostomy made. Following the operation the patient did pretty well for a couple of weeks. She then began to have epigastric pains as before the operation, and finally, after a downward course, during which she passed considerable blood from the bowel, she died. At autopsy, upon opening up the loop of jejunum just beneath the gastrojejunostomy, it was found that the outer serous suture, which was a continuous one of linen thread, was hanging in the bowel. Half had ulcerated out and half was retained. The inner layer of suture was chromic catgut and there was no trace of it. The in-turned end of the stomach which had been sutured in much the same way as the gastro-enterostomy, *i.e.*, with a linen suture outside and chromic gut within, showed much the same condition, and the linen thread was hanging part way in the lumen of the stomach. The condition was very suggestive; if the patient had lived, ultimately both sutures probably would have pulled out; but it is easy to suppose that such a suture in place for some time might set up chronic ulcer and be the foundation of gastrojejunal ulcer.

DR. J. EDWIN SWEET said that in the laboratory of surgical research they used silk for all coats of the intestines. They have seen many gastrojejunostomies with the silk sutures sloughing away with no evidence of ulcer forming about them. One can well imagine that silk thread in a gastric mucosa, which was, as evidenced by previous history, subject to ulcer formation, might be an added irritation, but one can hardly conceive of how silk thread alone in a normal mucosa could be held responsible.

DR. NATHANIEL GINSBURG said that with reference to the unabsorbable suture in relation to gastrojejunal ulcer, this is not the sole factor responsible for the development of this lesion. Chronic irritation at the line of union maintained by hyperacidity and the presence of the suture acting as a foreign body, in some cases, is the causative element in the production of the ulcer at the stoma site.

Lieblein supports the contention that hyperacid gastric contents plus the traumatism occasioned by the suture at the anastomosis site is a very important etiological factor. He quotes the work of Wilkie, of

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Edinburgh, who, in his animal experimentation, used silk sutures and later fed the animals upon a hyperacid diet. He was able to produce jejunal and gastrojejunal ulcers in his animals, using a control set of cats to whom he did not feed hyperacid diet following operation, and in whom ulcer was not produced. It must be borne in mind, however, that the physiology of the gastro-intestinal path of the human and the lower animal type differs markedly, and that the nervous system which is such an important factor in the human plays little part in experimental work upon dogs and cats.

In a discussion some years ago, Cannon stated that he fed animals with shot whom he had gastro-enterostomatized without closure of the pylorus. His radiograph showed a shot with a string attached, having passed through the patent pylorus. He contended that the best functional result therefore occurs if the pylorus is occluded when gastro-enterostomy is done, thereby forcing all the gastric contents through the stoma.

Patterson replied that he was unable to speak from experimental work upon dogs, but he never fed his patients upon shot, inferring that the difference between human and animal surgery must always be borne in mind in making deductions when the final summary is drawn.

A NEW NEEDLE-HOLDER

DR. J. E. SWEET presented a needle-holder and said that his reason for attempting the design of a new instrument is to be found in the slightly unusual conditions surrounding the operative work in the Research Laboratory and in the fact that no instrument of which he had knowledge satisfactorily fulfilled these conditions. They have found from experience that their patients, since they will not be quiet after an operation, but will be as active as before, must have their wounds so repaired that the strain will be withstood. They have found that this can only be accomplished by the use of interrupted sutures in the layer of the wound which normally carries the chief strain—the aponeurosis layer in a midline wound, for instance—and these interrupted sutures must be laid not over one-eighth to one-quarter inch apart. Further, they must prepare their own suture material. The result of this is that they try to avoid the loss of time caused by the threading of many needles, and therefore adopt the technic of starting with a long thread, tying each suture as laid, thus saving time and suture material. With the common needle-holder this means that the suture is placed, the needle-holder laid down, the suture tied, scissors picked up, the suture cut, the scissors laid down, and the needle-holder taken

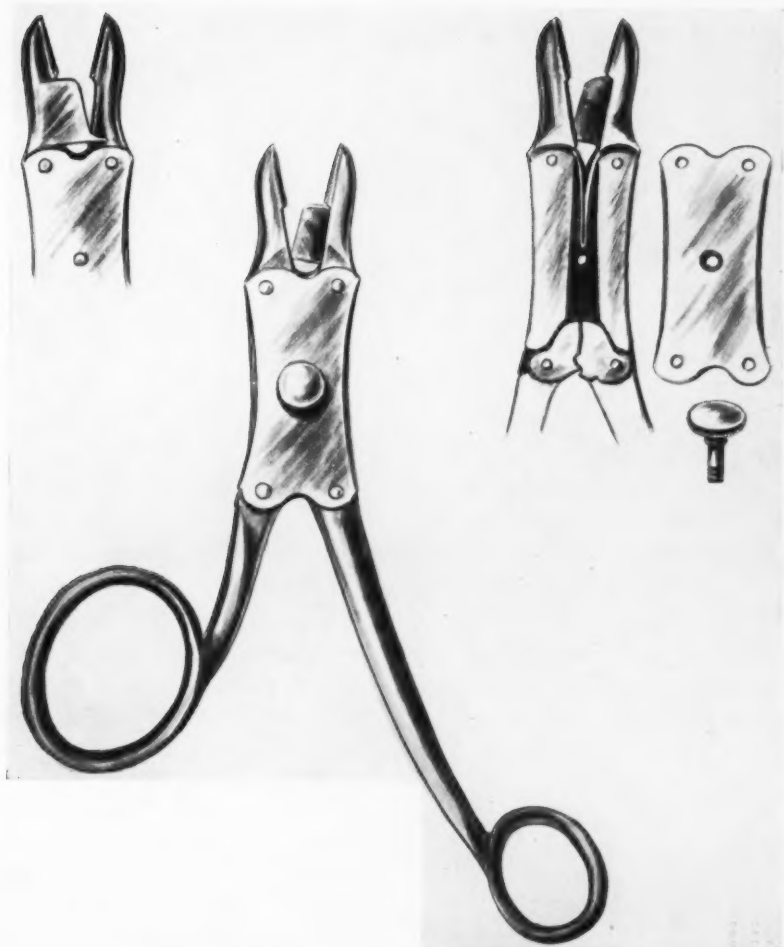


FIG. 8.—Sweet's needle-holder.



A NEW NEEDLE-HOLDER

up again. He therefore wanted a holder which could be held in the hand, and yet leave the thumb and fingers free for tying. This principle is found in the handles of the Kocher scissors. Since one of these handles is very short, and therefore permits of but short leverage, he introduced the principle of the double-lever joint, such as is used in powerful cutting implements, as bolt cutters, heavy wire cutters, etc.

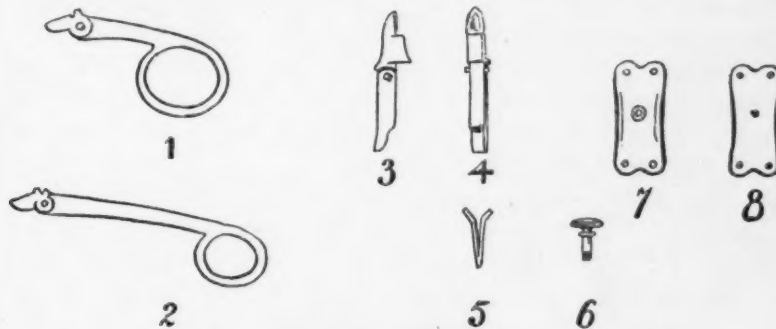


FIG. 9.—The component parts of needle-holder.

This gives great power at the jaw, and enabled him to dispense with any form of catch for the handles; a comparatively light pressure on the handles holds the needle firmly, and any form of catch, with the well-known troubles inherent to them, is unnecessary. The scissors attachment is not new in principle, nor is the form of the jaw. It is not unlikely that in this form of instrument, with the bearings supported at each end, the alignment of the scissors blades will be kept more perfect than in other types. By removing the one screw the entire mechanism comes apart for cleaning.

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IN MEMORIAM
J. WILLIAM WHITE

SINCE January, 1892, nearly twenty-five years, the title page of the ANNALS OF SURGERY has borne the name of Dr. J. William White, of Philadelphia, as one of its collaborating editors. It is with profound grief and a deep sense of loss that we now have to record his death, which took place on April 24, after many months of disability and suffering. It will be the privilege of others to speak of the characteristics as a citizen, a teacher and a surgeon, which he displayed during the years of his active and laborious life. It is meet, however, that the ANNALS OF SURGERY should not allow the hour to pass without some record of the part which he played in its development. Our special relations began in the latter part of 1891 when, through his initiative and influence, this JOURNAL was acquired by the University of Pennsylvania Press, and its place of publication transferred from St. Louis to Philadelphia. He consented at that time to become one of the collaborators in the work of the JOURNAL and secured the further addition to its staff of Mr. Frederick Treves, of London, who was his intimate friend. When the proprietorship of the JOURNAL was taken over by the house of J. B. Lippincott Company, in 1897, Dr. White's interest in it still continued, and we have had the benefit of his advice and assistance until the hour of his death. Looking back over the past it is plain that the change in the home of the JOURNAL which occurred in 1892 had a great influence in opening up the possibilities in the field of surgical journalism which it has since been able to realize, so that all who are interested in it or are served by it should not fail to give to Dr. White credit for the result which he secured.

Of all the characteristics which Dr. White presented in so notable a degree none was more pronounced than that of loyalty to his friends and to the causes which he espoused. He was a tower of strength in whatever cause his interest was awakened. He was facile and quick in resource, broad and comprehensive in the fields of his endeavors and intense and unsparing of himself in his efforts to accomplish those ends which appealed to him as desirable.

LEWIS S. PILCHER.

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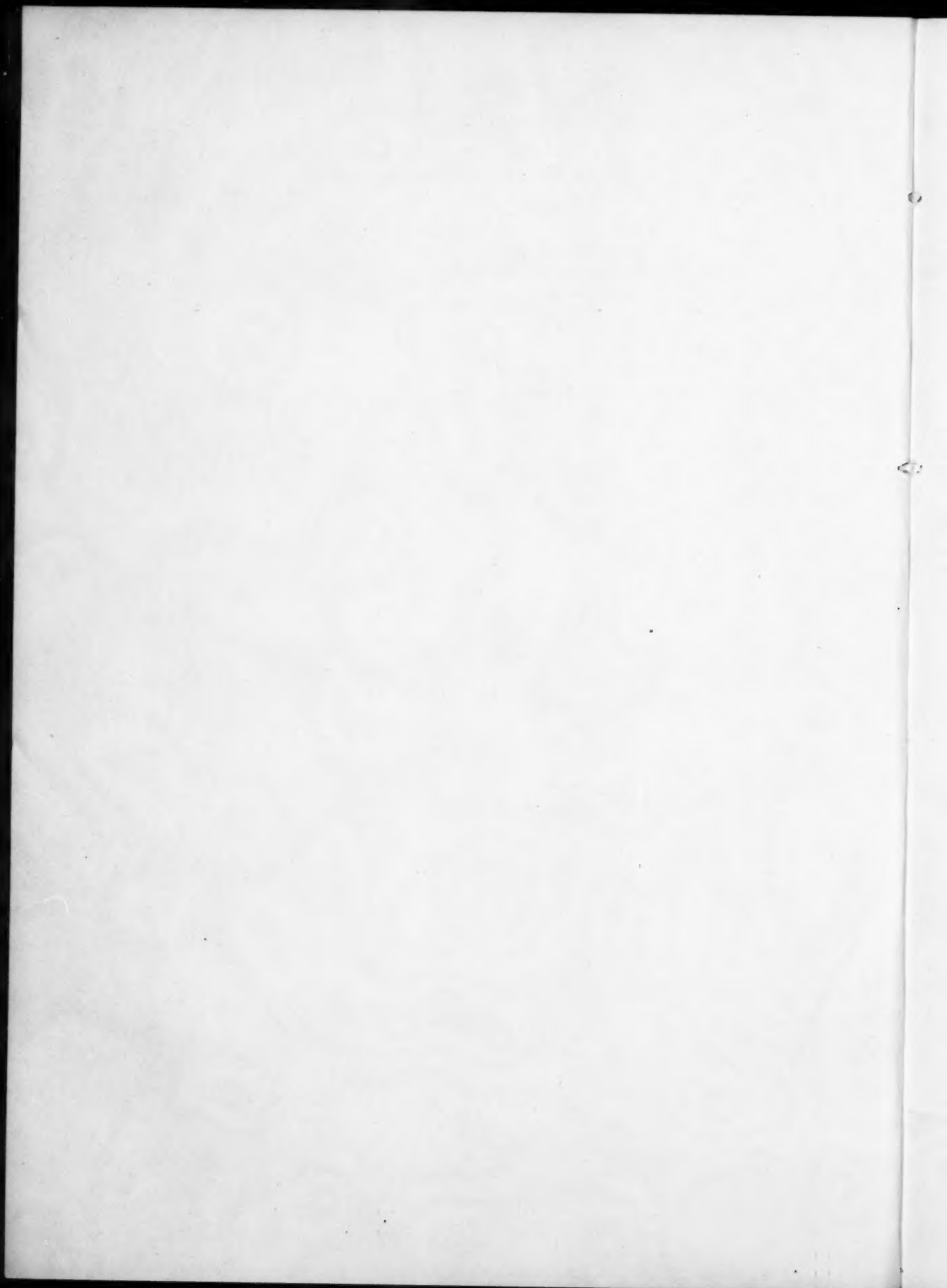
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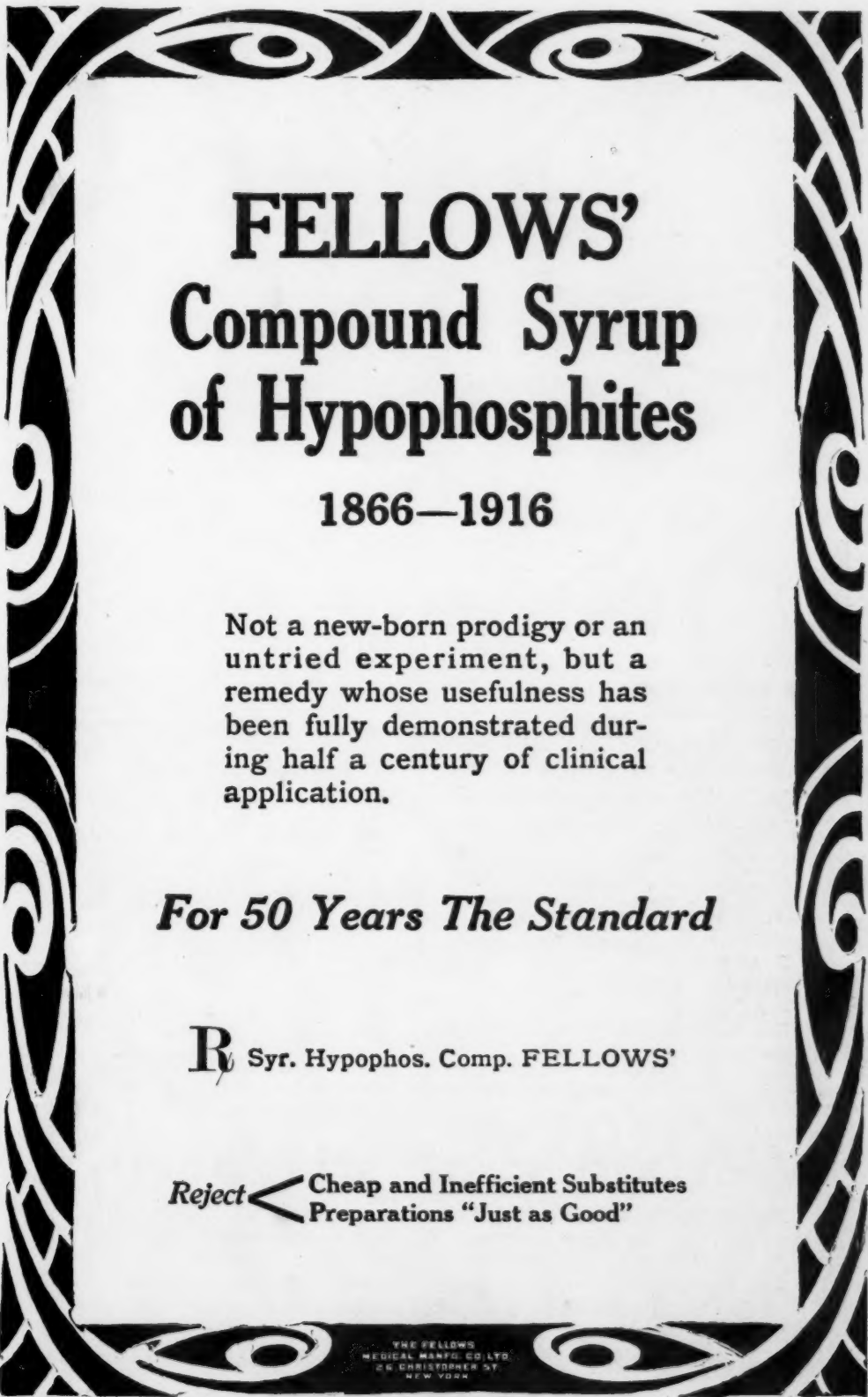
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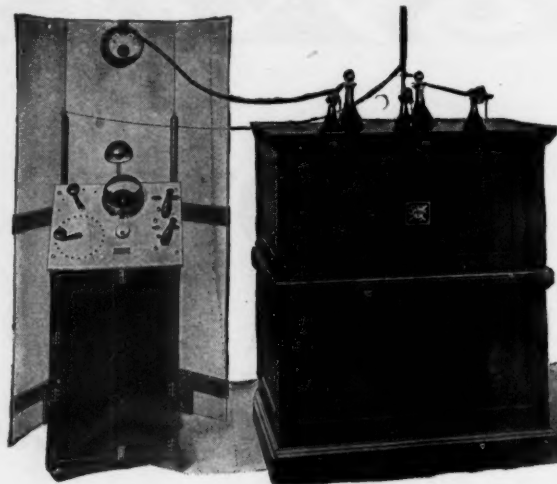
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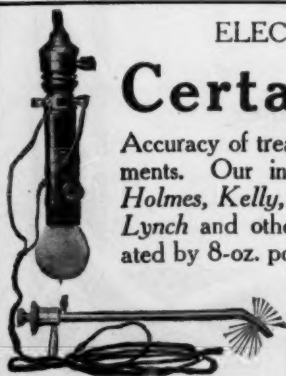
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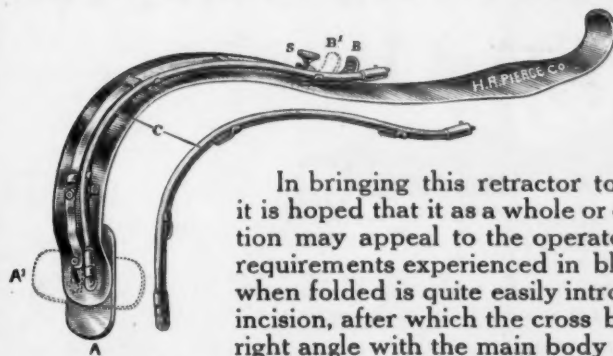


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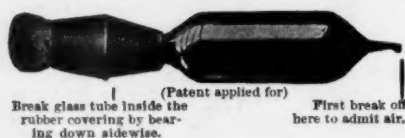
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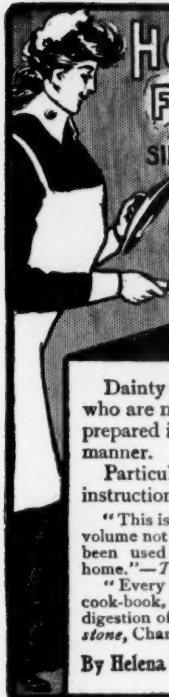
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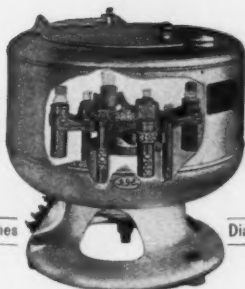
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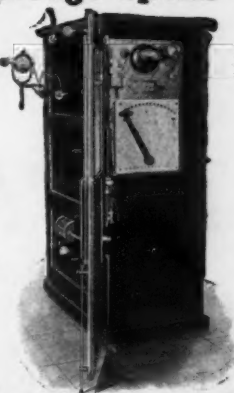
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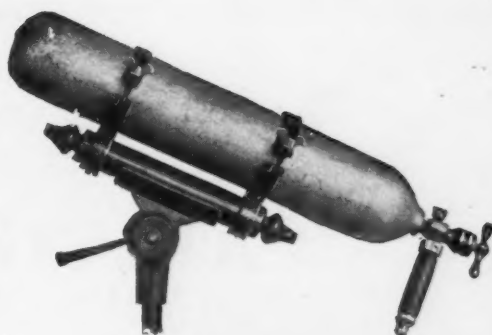
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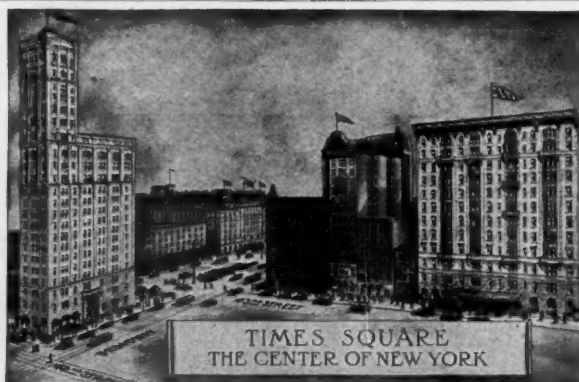
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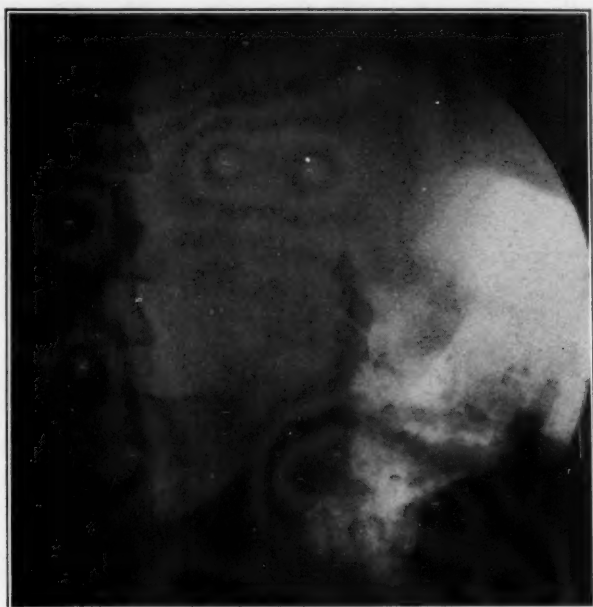
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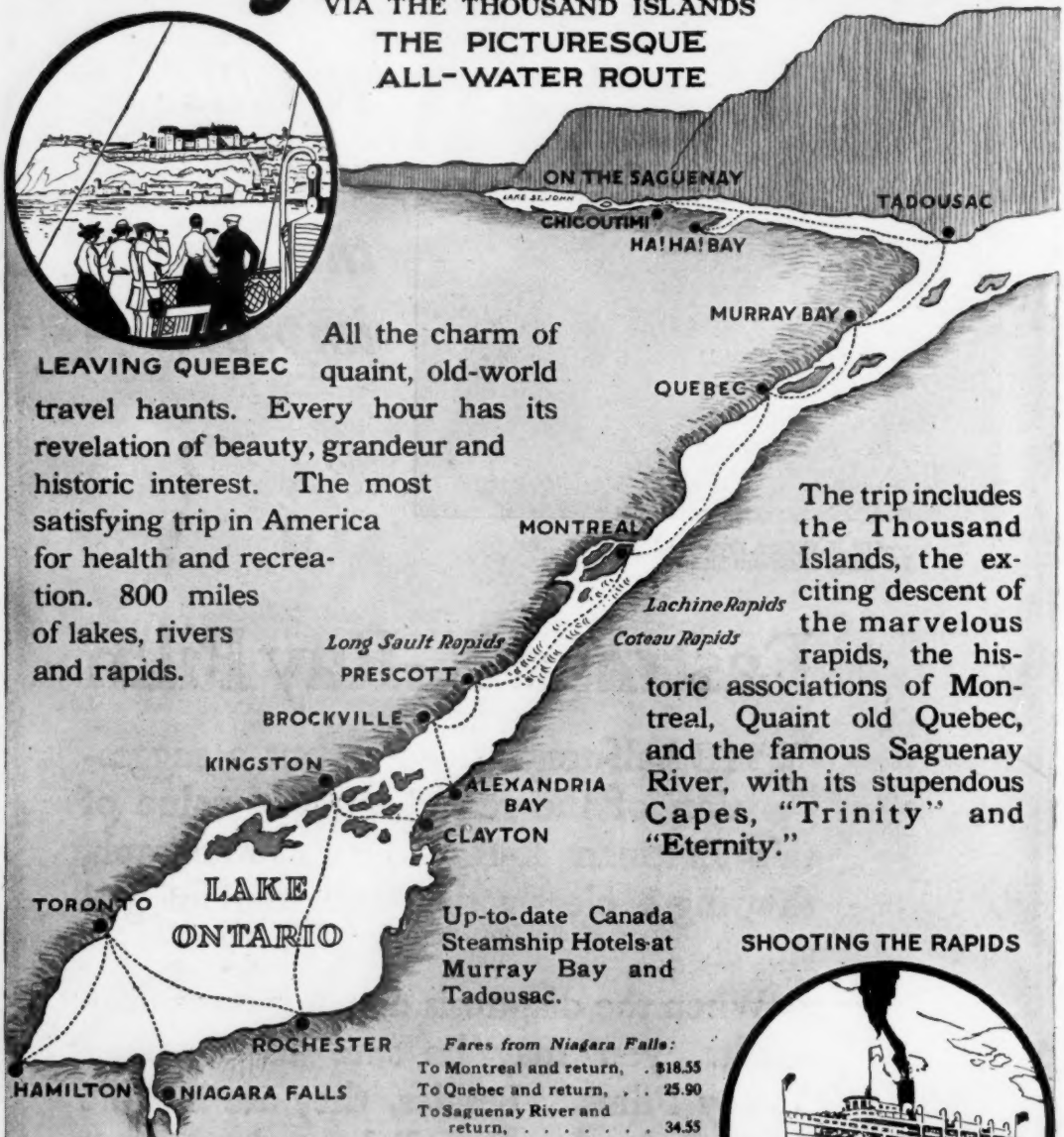
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